

Piervincenzo Rizzo, Ph.D.
Curriculum Vitae

Professor

Director, Laboratory for Nondestructive Evaluation and Structural Health Monitoring Studies
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Research Areas of Interest

- Nondestructive evaluation (NDE),
- Structural health monitoring (SHM),
- Signal processing, nonlinear dynamics, energy harvesting,
- Application of NDE and SHM in bioengineering.

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CAREER SUMMARY

RESEARCH

- Secured **46 grants** (including travel grants and teaching) for over \$6M in federal and non-federal, solicited and unsolicited, external and internal grants. Of these \$6M, over \$4.3M were awarded and managed directly by Dr. Rizzo who **was the PI in 40 of the 46 grants**.
- Federal Agencies that have funded my projects: National Science Foundation (eight grants without including supplements, Federal Railroad Administration, TRB Transit Idea program (National Academy of Sciences).
- Other Sponsors: CEATI International Inc., Pennsylvania Department of Transportation, American Society for Nondestructive Testing (ASNT), American Association of Railroads, University of Pittsburgh.
- Published **more than 100** peer reviewed journal articles and over **150** conference proceedings and technical reports. Current Google Scholar h-index: **35** (according to Google Scholar). Scopus h-index as of May 2019: **25**.
- Given 25 invited presentation.
- Graduated 5 Ph.D. and 7 M.S. thesis students. Advised 2 post-docs, 15 foreign visiting Ph.D. and M.S. students, and six Pitt undergraduates. Hosted one visiting professor.
- Received two among the most prestigious awards in the field of SHM voted by peers.
- Received the most esteemed award granted by the University of Pittsburgh to its own young faculty.
- Granted two patents.

TEACHING

- Introduced and developed an elective cross-listed course in NDE and SHM at UPitt.
- Secured federal and non-federal funding to improve class curricula
- Modernized some ENGR and CEE graduate and undergraduate courses
- Taught ENGR pillar courses in the CEE curriculum.
- Secured NSF funding for developing innovative engineering education programs.

SERVICE

- Served in several Department, School, and University Committees including three CEE Faculty search committees served as chair, SSOE Appointment, Promotion, and Tenure Review Committee and the University's Conflict of Interest Committee.
 - Organizing member of several conferences and chaired several sessions at conferences. Serving on the editorial board of five (5) journals. Served as reviewer for **over hundred-twenty (126) different journals**.
 - Reviewed proposals for **twenty-four** different funding/program mechanisms (U.S. and foreign).
 - **Steering, organizing, and chairing the 10th European Workshop on Structural Health Monitoring, www.ewshm2020.com to be held in Italy in July 2020 (due to COVID-19, the event was postponed to July 2022).**
 - Participated and/or promoted many initiatives to foster the participation of underrepresented groups in engineering research.
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A) Educational Background

- (2004) Ph.D. in Structural Engineering,
University of California, San Diego (UCSD)
Title: *Health Monitoring of Tendons and Stay Cables for Civil Structures*
Advisor: Prof. Francesco Lanza di Scalea.
- (2002) M.S. in Structural Engineering, GPA-3.73/4.00, UCSD.
- (1998) Laurea (5-yrs degree) in Aeronautical Engineering (1998), 110/110 magna cum laude,
University of Palermo, Italy
Thesis Title: *Finite Element Analysis of Laminate Composite Panels with High-Order Mixed Formulation* (in Italian).
Advisor: Prof. Santi Rizzo¹, former Dean of the School of Engineering.
Co-Advisor: Dr. Roberto Spallino (now Chief Engineer at AIRBUS, Germany).

B) Professional Experience

- (Sept. 2018 -): Professor with tenure, Dept. of Civil & Environmental Engineering, University of Pittsburgh
- (Sept. 2012 – Aug. 2018): Associate Professor with tenure, Dept. of Civil & Environmental Engineering, University of Pittsburgh
- (Sept. 2013 – April 2014): Visiting Professor, Dept. of Civil, Aerospace, and Materials Engineering, University of Palermo, Italy
- (Sept. 2006 – Aug. 2012): Assistant Professor, Dept. of Civil & Environmental Engineering, University of Pittsburgh
- (Aug. 2005 – Aug 2006): Assistant Project Scientist, Dept. of Structural Engineering, UCSD
- (May 2004 – July 2005): Postdoctoral Scholar, Dept. of Structural Engineering, UCSD
- (Fall 2002, Spring 2003): Teaching Assistant, Dept. of Structural Engineering, UCSD: taught Solid Mechanics I, Solid Mechanics II
- (Jan. 2001 – Apr. 2004): Graduate Student Researcher, Dept. of Structural Engineering, UCSD.
- (Apr. 2000 – Dec. 2000): Assistant Development Engineer, Dept. of Structural Engineering, UCSD. Conducted research in the area of Acoustic Emission. Submitted and published two peer-reviewed papers and few conference papers.
- (Jan. 1999 – Mar. 2000): Technical Army Officer (rank under-lieutenant), Italian Army Corps of Engineering, technical office of the Aviation Army base located in Bologna, Italy. Created a database for the management of helicopters' work repairs, reviewed helicopters' maintenance procedures, and responded to the normal duties of an Army officer.

B.1 Professional License

Licensed Professional Engineer in Italy (1999 - 2015)

¹ There is no family relationship.

C) **Publications** (bolded when I am the corresponding author; the asterisk indicates the students I advised).

According to **Google Scholar** (Last date accessed October 21, 2020):

Citations for 'Piervincenzo Rizzo': 4006

Cited Publications at least once: 140+

H-Index: 36, i-10 Index: 94

According to **Scopus** (Last date accessed May 22, 2020):

Citations for 'Piervincenzo Rizzo': 2518

H-Index: 27

C.1 Refereed Publications

C.1.(i) Refereed journal papers

- 107 *Enshaeian, A. and **Rizzo, P.** (2020). “Stability of Continuous Welded Rails: A State-of-the-Art Review of Structural Modeling and Nondestructive Evaluation,” *The Proceedings of the Institution of Mechanical Engineers, Part F: Journal of Rail and Rapid Transit*, tentatively accepted, under second round of review.
- 106 *Enshaeian, A. and **Rizzo, P.** (2020). “Bridge Health Monitoring in the United States: a Review,” under review.
- 105 *Enshaeian, A., Luan, L., *Belding, M., Sun, H., and **Rizzo, P.** (2020). “Numerical Analysis and Experimental Validation of a Contactless Monitoring Approach for Continuous Welded Rails,” under review.
- 104 Misra, R., *Jalali, H., Dickerson, S., and **Rizzo, P.** (2020). “Wireless Module for Nondestructive Testing/Structural Health Monitoring Applications Based on Solitary Waves,” *Sensors*, Special Issue “Advanced Sensors for Real-Time Monitoring Applications”, **20**, 3016.
- 103 *Jalali, H. and **Rizzo, P.** (2020). “Highly nonlinear solitary waves for the detection of localized corrosion,” *Smart Materials and Structures*, in press.
- 102 *Nasrollahi, A., and **Rizzo, P.** (2020). “Modeling a New Dynamic Approach to Measure Intraocular Pressure with Solitary Waves,” *Journal of the Mechanical Behavior of Biomedical Materials*, **103**, March 2020, 103534, <https://doi.org/10.1016/j.jmbbm.2019.103534> .
- 101 *Zheng, B., **Rizzo, P.**, and *Nasrollahi, A. (2020). “Outlier Analysis of Nonlinear Solitary Waves for Health Monitoring Applications,” *Structural Health Monitoring, an International Journal*, **19**(4), 1160-1174, article first published online: October 10, 2019; <https://doi.org/10.1177/1475921719876089>.
- 100 **Rizzo, P.** (2020). “A review on the latest advancements in the non-invasive evaluation/monitoring of dental and trans-femoral implants,” Invited paper, *Biomedical Engineering Letters*, **10**, 83–102, <https://doi.org/10.1007/s13534-019-00126-8>.
- 99 *Jalali, H., **Rizzo, P.**, and *Nasrollahi, A. (2019). “Asymmetric propagation of low-frequency acoustic waves in a granular chain using asymmetric intruders,” *Journal of Applied Physics*, **126**, 075116 (2019), 13 pages; <https://doi.org/10.1063/1.5085347>.
- 98 *Nasrollahi, A., and **Rizzo, P.** (2019). “Numerical analysis and experimental validation of a nondestructive evaluation method to measure stress in rails,” *ASME Journal of Nondestructive Evaluation, Diagnostics and Prognostics of Engineering Systems*, August 2019, Vol. 2 / 031002-1, 12 pages, **awarded third place as 2019 Best Paper**.

- 97 Monaco, E., *Nasrollahi, A., Boffa, N.B., Memmolo, V., Rizzo, P., and Ricci, F. (2019). “Ultrasonic-GW tomographic analysis and probabilistic reconstruction approach for SHM applications,” *Aerotec. Missili Spaz.*, **98**(2), June 2019, 131–137 <https://doi.org/10.1007/s42496-019-00010-9>.
- 96 *Nasrollahi, A., *Sefa Orak, M., Kosinski, K., James, A., Weighardt, L., and **Rizzo, P.** (2019). “An NDE approach to characterize tennis balls,” *ASME Journal of Nondestructive Evaluation, Diagnostics and Prognostics of Engineering Systems*, **2**, 011004-1, (8 pages).
- 95 *Nasrollahi, A., *Lucht², R., and **Rizzo, P.** (2019). “Solitary waves to assess the internal pressure and the rubber degradation of tennis balls” *Experimental Mechanics*, **59**(1), 65-77. DOI: DOI 10.1007/s11340-018-0432-1.
- 94 *Nasrollahi, A., and **Rizzo, P.** (2018) “Axial stress determination using highly nonlinear solitary waves,” *The Journal of the Acoustical Society of America*, **144**, 2201-2212, doi: 10.1121/1.5056172.
- 93 *Sefa Orak, M., *Nasrollahi, A., Ozturk, T., Mas, D., Ferrer, B., and **Rizzo, P.** (2018) “Non-contact smartphone-based monitoring of thermally stressed structures,” *Sensors journal*, **18**, 1250, <http://dx.doi.org/10.3390/s1804125>.
- 92 *Nasrollahi, A., **Rizzo, P.**, and *Sefa Orak, M. (2018) “Numerical and experimental study of the dynamic interaction between highly nonlinear solitary waves and pressurized balls,” *ASME Journal of Applied Mechanics*, **85**(3), 031007-1 031007-11.
- 91 La Malfa Ribolla, E., Rezaee Hajidehi, M., Rizzo, P., Fileccia Scimemi, G., Spada, A., Giambanco, G. (2018). “Ultrasonic inspection for the detection of debonding in CFRP-reinforced concrete”, *Structure and Infrastructure Engineering*, **14**(6), 807-816. DOI : <http://dx.doi.org/10.1080/15732479.2017.1384843>.
- 90 *Nasrollahi, A., *Deng, W., *Ma, Z., and **Rizzo, P.**, (2018) “Multimodal structural health monitoring based on active and passive sensing,” *Structural Health Monitoring, an International Journal*, **17**(2) 395–409 <http://journals.sagepub.com/eprint/xDsh4IkNzpBRe55dYY6J/full>.
- 89 *Deng, W., *Nasrollahi, A. **Rizzo, P.**, and *Li, T. (2017) “Merging Three NDT Technique into a Single SHM system,” *Materials Evaluation*, **75**(10), 1301-1309.
- 88 *Li, K., and **Rizzo, P.** (2017) “Analysis of the geometric parameters of a solitary waves-based harvester to enhance its power output,” *Smart Materials and Structures*, **26**, 075004 (14pp) <https://doi.org/10.1088/1361-665X/aa7401>.
- 87 **Rizzo, P.**, and *Li, K. (2017). “Impurity detection in a chain of spherical particles using time reversal and highly nonlinear solitary waves,” *Journal of Applied Physics*, **121**, 145105 (2017); doi: 10.1063/1.4980104.
- 86 Bagheri, A., **Rizzo, P.**, and Li, K. (2017) “Ultrasonic Imaging Algorithm for the Health Monitoring of Pipes,” *Journal of Civil Structural Health Monitoring*, **7**, 99–121, DOI 10.1007/s13349-017-0214-y.
- 85 *Nasrollahi, A., *Deng, W., **Rizzo, P.**, Vuotto, A., and Vandenbossche, J.M. (2017) “Nondestructive testing of concrete using highly nonlinear solitary waves,” *Nondestructive Testing and Evaluation*, **32**(4), 381-399, <http://dx.doi.org/10.1080/10589759.2016.1254212>.
- 84 *Li, K., and **Rizzo, P.** (2017) “Experimental parametric analysis of an energy harvester based on highly nonlinear solitary waves,” *Journal of Intelligent Material Systems and Structures*, **28**(6), 772-781, <http://journals.sagepub.com/doi/full/10.1177/1045389X16657422>

² High-school student conducting research in my lab.

- 83 *Bagheri, A., and **Rizzo, P.** (2017) “Assessing the pressure of tennis balls using nonlinear solitary waves: a numerical study,” *Sports Engineering*, **20**(1), 53–62 <http://link.springer.com/article/10.1007/s12283-016-0217-7/fulltext.html>.
- 82 *Bagheri, A., Hosseinzadeh, A.Z. Ghodrati Amiri, G., Rizzo, P. (2017). “Time Domain Damage Localization and Quantification in Seismically Excited Structures Using a Limited Number of Sensors,” *Journal of Vibration and Control*, **23**(18), 2942-2961. <http://journals.sagepub.com/doi/full/10.1177/1077546315625141> .
- 81 **Rizzo, P.**, *Nasrollahi, A., *Deng, W., and Vandenbossche, J.M. (2016) “Detecting the presence of high water-to-cement ratio in concrete surfaces using highly nonlinear solitary waves ,” *Applied Sciences. Featured article in the special issue: Acoustic and Elastic Waves: Recent Trends in Science and Engineering*, **6**, 104, 16 pages; doi:10.3390/app6040104.
- 80 *Evola, P., **Rizzo, P.**, and *Vandone, A. (2016). “Fractal Analysis Applied to Laser-spot Thermography,” *Materials Evaluation*, **74**(3), 409-417. **Voted ASNT Outstanding Paper 2017.**
- 79 *Deng, W., *Nasrollahi, A., **Rizzo, P.**, and *Li, K. (2016) “On the Reliability of a Solitary Wave Based Transducer to Determine the Characteristics of some Materials,” *Sensors*, **16**, 5; doi:10.3390/s16010005, 19 pages.
- 78 *Li, K., and **Rizzo, P.** (2016) “Nonreciprocal propagation of acoustic waves in granular chains with asymmetric potential barriers,” *Journal of Sound and Vibration*, **365**, 15-21, doi:10.1016/j.jsv.2015.11.032.
- 77 *Bagheri, A., and **Rizzo, P.** (2016) “Guided ultrasonic wave testing of an immersed plate with hidden defects,” *Optical Engineering, special issue on Structural Health Monitoring*, **55**(1), 011003, doi:10.1117/1.OE.55.1.011003.
- 76 *Bagheri, A., *La Malfa Ribolla, E., **Rizzo, P.**, and Al-Nazer, L. (2016) “On the coupling dynamics between thermally stressed beams and granular chains,” *Archive of Applied Mechanics*, **86**(3), 541-556.
- 75 *Bagheri, A., **Rizzo, P.**, and Al-Nazer, L. (2016). “A Numerical Study on the Optimization of a Granular Medium to Infer the Axial Stress in Slender Structures,” *Mechanics of Advanced Materials and Structures*, **23**(10), 1131-1143, DOI: 10.1080/15376494.2015.1039679.
- 74 *Li, K., **Rizzo, P.**, and *Bagheri, A. (2015). “A parametric study on the optimization of a metamaterial-based energy harvester,” *Smart Materials and Structures*, **24**, 115019 (11pp), doi:10.1088/0964-1726/24/11/115019.
- 73 *La Malfa Ribolla, E., and **Rizzo, P.** (2015) “Modeling the electromechanical impedance technique for the assessment of dental implant stability,” *Journal of Biomechanics*, **48**(10), 1713–1720, DOI: 10.1016/j.jbiomech.2015.05.020.
- 72 *Li, K., and **Rizzo, P.** (2015) “Energy harvesting using arrays of granular chains and solid rods,” *Journal of Applied Physics*, **117**, 215101.
- 71 *Gulizzi V., **Rizzo, P.**, Milazzo, A., and *La Malfa Ribolla, E. (2015) “An integrated structural health monitoring system based on electromechanical impedance and guided ultrasonic waves,” *Journal of Civil Structural Health Monitoring*, **5**(3), 337-352. <http://link.springer.com/article/10.1007/s13349-015-0112-0> .
- 70 *Gulizzi V., **Rizzo, P.**, and Milazzo, A. (2015) “On the Repeatability of Electromechanical Impedance for Monitoring of Bonded Joints,” *AIAA Journal*, **53**(11), 3479-3483, doi: <http://arc.aiaa.org/doi/abs/10.2514/1.J053682>.
- 69 *Bagheri A., *Pistone, E., and **Rizzo, P.** (2015) “Outlier Analysis and Artificial Neural Network for the Non-contact Nondestructive Evaluation of Immersed Plates,” *Research*

- in Nondestructive Evaluation*, **26**(3), 154-173.
- 68 *Li, K., and **Rizzo, P.** (2015) “Energy Harvesting Using an Array of Granules,” *ASME Journal of Vibration and Acoustics*, **137**(4), 041002, (Aug 01, 2015) (10 pages), doi:10.1115/1.4029735.
- 67 *Pistone, E., and **Rizzo, P.** (2015) “On the Use of an Array of Ultrasonic Immersion Transducers for the Nondestructive Testing of Immersed Plates,” *Nondestructive Testing and Evaluation*, **30**(1), 26-38, DOI:10.1080/10589759.2014.979817.
- 66 *Bagheri, A., *La Malfa Ribolla, E., **Rizzo, P.**, Al-Nazer, L., and Giambanco, G. (2015). “On the use of L-shaped granular chains for the assessment of thermal stress in slender structures,” *Experimental Mechanics*, **55**(3), 543-558.
- 65 *La Malfa Ribolla, E., **Rizzo, P.**, and *Gulizzi, V. (2015) “On the use of the electromechanical impedance technique for the assessment of dental implant stability: Modeling and Experimentation,” *Journal of Intelligent Materials and Structures*, **26**(16), 2266-2280, DOI: 10.1177/1045389X14554129.
- 64 *Bagheri, A., **Rizzo, P.**, and Al-Nazer, L. (2015). “Determination of the neutral temperature of slender beams by using nonlinear solitary waves,” *ASCE Journal of Engineering Mechanics*, **141**(6), 04014163 (8 pages), DOI: 10.1061/(ASCE)EM.1943-7889.0000886.
- 63 *Gulizzi, V., **Rizzo, P.**, and Milazzo, A. (2014) “Electromechanical Impedance Method for the Health Monitoring of Bonded Joints: Numerical Modelling and Experimental Validation,” *Structural Durability and Health Monitoring*, **10**(1), 19-54.
- 62 **Rizzo, P.**, *Ni, X., *Nassiri, S., and Vandenbossche, J. (2014). “Solitary wave based sensor to monitor the setting of fresh concrete,” *Sensors, section Physical Sensors*. Special issue: Novel Sensors for Non-Destructive Testing and Structural Health Monitoring, **14**, 12568-12584; doi:10.3390/s140712568.
- 61 *Li, K., **Rizzo, P.**, and *Ni, X. (2014) “Alternative Designs of Acoustic Lenses based on Nonlinear Solitary Waves,” *ASME Journal of Applied Mechanics*, **81**(7), 071011 (Apr 25, 2014), doi: 10.1115/1.4027327.
- 60 *Bagheri, A., Persano Adorno, D., Rizzo, P., Barraco, R., and Bellomonte, L. (2014). “Empirical Mode Decomposition and Neural Network for the Classification of Electroretinographic Data,” *Medical & Biological Engineering & Computing*, **52**(7), 619-628.
- 59 *Zhu, X., and **Rizzo, P.** (2014). “Sensors Array for the Health Monitoring of Truss Structures by means of Guided Ultrasonic Waves”, *Journal of Civil Structural Health Monitoring*, **4**(3), pp 221-234, doi: 10.1007/s13349-014-0078-3.
- 58 Chen, S., Cerda, F., Rizzo, P., Bielak, J., Garrett, J., and Kovačević, J. (2014). “Semi-supervised multiresolution classification using adaptive graph filtering with application to indirect bridge structural health monitoring”. *IEEE Transactions on Signal Processing*, **62**(11), 2879-2893, DOI: 10.1109/TSP.2014.2313528.
- 57 Cerda, F., Chen, S., Bielak, J., Garrett, J., Rizzo, P. and Kovačević, J. (2014). “Indirect Structural Health Monitoring of a Simplified Laboratory-scale Bridge Model”. *Smart Structures and Systems* (Special Issue: Challenge on bridge health monitoring utilizing vehicle-induced vibrations), **13**(5), 849-868. DOI: 10.12989/sss.2014.13.5.849.
- 56 *Bagheri, A., *Pistone, E., and **Rizzo, P.** (2014). “Guided ultrasonic wave imaging for immersed plates based on wavelet transform and probabilistic analysis,” *Research on Nondestructive Evaluation*, **25**, 1-19, DOI: 10.1080/09349847.2013.837212.
- 55 *Pistone, E., *Li, K., and **Rizzo, P.** (2013) “Noncontact Monitoring of Immersed Plates by means of Laser-induced Ultrasounds,” *Int. Journal of Structural Health Monitoring*,

- September-November, **12**, 549-565, doi:10.1177/1475921713506767.
- 54 *Cai, L., **Rizzo, P.**, and Al-Nazer, L. (2013). “On the Coupling Mechanism between Nonlinear Solitary Waves and Slender Beams,” *International Journal of Solids and Structures*, **50**, 4173-4183, <http://dx.doi.org/10.1016/j.ijsolstr.2013.08.018>.
- 53 *Cai, L., Yang, J., **Rizzo, P.**, *Ni, X., and Daraio, C. (2013). “Propagation of Highly Nonlinear Solitary Waves in a Curved Granular Chain,” *Granular Matters*, **15**(3), 357-366, DOI: 10.1007/s10035-013-0414-z.
- 52 Lanza di Scalea, F., Rizzo, P., Salamone, S., Bartoli, I., and Al-Nazer, L. (2013). “Ultrasonic Tomography for Three-Dimensional Imaging of Internal Rail Flaws,” *Transportation Research Record, Journal of the Transportation Research Board*, Vol. **2374**, 162-168, DOI 10.3141/2374-19.
- 51 *Ni, X., *Cai, L., and **Rizzo, P.** (2013). “A Comparative Study on Three Different Transducers for the Measurements of Nonlinear Solitary Waves,” *Sensors*, special issue: Piezoelectric Sensors and Actuators, **13**, 1231-1246; doi:10.3390/s130101231.
- 50 *Zhu, X., and **Rizzo, P.** (2013). “Guided Waves for the Health Monitoring of Sign Support Structures Under Varying Environmental Conditions,” *Structural Control and Health Monitoring*, **20**(2), 36-52. Available online: 21 AUG 2011 | DOI: 10.1002/stc.481.
- 49 *Bagheri, A., *Li, K., and **Rizzo, P.** (2013). “Reference-free damage detection by means of wavelet transform and empirical mode decomposition applied to Lamb waves,” *Journal of Intelligent material Systems and Structures*, **24**(2), 194-208, DOI: 10.1177/1045389X12460433.
- 48 *Berhanu, B., **Rizzo, P.**, and Ochs, M (2013). “Highly Nonlinear Solitary Waves for the Assessment of Dental Implant Mobility,” *ASME J. Applied Mechanics*, **80**, 011028, <http://dx.doi.org/10.1115/1.4006947>.
- 47 *Tabrizi, A., **Rizzo, P.**, and Ochs, M (2012). “Electromechanical impedance method to assess dental implant stability,” *Smart Materials and Structures*, **21**(11), 115022 doi:10.1088/0964-1726/21/11/115022 (8 pp).
- 46 *Ni, X., **Rizzo, P.**, Yang, J., Kathri, D., and Daraio, C. (2012). “Monitoring the Hydration of Cement using Highly Nonlinear Solitary Waves,” *NDT&E International*, **52**(November), 76–85, <http://dx.doi.org/10.1016/j.ndteint.2012.05.003>.
- 45 *Ni, X., and **Rizzo, P.** (2012). “Use of highly nonlinear solitary waves in NDT,” *Materials Evaluation*, **70**(5), 561-569. **Voted ASNT Outstanding Paper 2013.**
- 44 *Zhu, X., and **Rizzo, P.** (2012). “A Unified Approach for the Structural Health Monitoring of Waveguides” *Structural Health Monitoring, an International Journal*, **11**(6), 629-642.
- 43 *Ni, X., and **Rizzo, P.** (2012). “Highly nonlinear solitary waves for the inspection of adhesive joints,” *Experimental Mechanics*, **52**(9), 1493-1501.
- 42 *Vandone, A., **Rizzo, P.**, and Vanali, M. (2012). “Two-Stage Algorithm for the Analysis of Infrared Images,” *Research in Nondestructive Evaluation*, **23**(2), 69-88.
- 41 *Spada, A., **Rizzo, P.**, and Giambanco, G. (2012). “Elastoplastic Damaging Model for Adhesive Anchor Systems. Part II: Numerical and Experimental Validation,” *ASCE Journal of Engineering Mechanics*, **137**(12), 854-861.
- 40 *Spada, A., Giambanco, G., and **Rizzo, P.** (2012). “Elastoplastic Damaging Model for Adhesive Anchor Systems. Part I: Theoretical Formulation and Numerical Implementation,” *ASCE Journal of Engineering Mechanics*, **137**(12), 862-876.
- 39 *Ni, X., **Rizzo, P.**, and Daraio, C. (2011). “Laser-based excitation of nonlinear solitary waves in a chain of particles,” *Physical Review E*, **84**, 026601, 5 pages.

- 38 *Boemio, G., **Rizzo, P.**, and De Nardo, L. (2011). "Assessment of Dental Implant Stability by Means of the Electromechanical Impedance Method," *Smart Materials and Structures*, **20**, 045008 (11pp) doi:10.1088/0964-1726/20/4/045008.
- 37 *Sale, M., **Rizzo, P.**, and Marzani, A. (2011). "Semi-Analytical Formulation for the Guided Waves-Based Reconstruction of Elastic Moduli," *Mechanical Systems and Signal Processing*, **25**(6), pp. 2241-2256.
- 36 *Ni, X., **Rizzo, P.**, and Daraio, C. (2011). "Actuators for the Generation of Highly Nonlinear Solitary Waves," *Review of Scientific Instruments*, **82**, 034902 (2011); doi:10.1063/1.3556442 (6 pages).
- 35 **Rizzo, P.**, Han, J., and *Ni, X. (2010). "Structural Health Monitoring of Immersed Structures by Means of Guided Ultrasonic Waves," *Journal of Intelligent Materials and Structures*, **21**, pp. 1397-1407, doi:10.1177/1045389X10384170
- 34 *Cammarata, M., **Rizzo, P.**, Dutta, and D., Sohn, H. (2010). "Application of Principal Component Analysis and Wavelet Transform to Fatigue Crack Detection in Waveguides," *Smart Structures and Systems*, **6**(4), pp. 349-362.
- 33 **Rizzo, P.**, *Cammarata, M., Bartoli, I., Lanza di Scalea, F., Salamone, S., Coccia, S., and Phillips, R. (2010). "Ultrasonic Guided Waves-Based Monitoring of Rail Head: Laboratory and field tests," *Advances in Civil Engineering*, Article ID 291293, 13 pages. doi:10.1155/2010/291293.
- 32 **Rizzo, P.** (2010). "Water and Wastewater Pipe Nondestructive Evaluation and Health Monitoring: A Review," *Advances in Civil Engineering*, Article ID 818597, 13 pages, doi:10.1155/2010/818597.
- 31 *Kacin, J., **Rizzo, P.**, and Tajari M. (2010). "Fatigue Analysis of Overhead Sign Support Structures," *Engineering Structures*, **32**(6), pp. 1659-1670.
- 30 *Zhu, X., **Rizzo, P.**, Marzani, A., and Bruck, J. (2010). "Ultrasonic guided waves for nondestructive evaluation/structural health monitoring of trusses," *Measurement Science and Technology*, **21**, 045701, doi: 10.1088/0957-0233/21/4/045701.
- 29 **Rizzo, P.**, *Spada, A., *Degala, S., and Giambanco, G. (2010). "Acoustic Emission Monitoring of Chemically Bonded Anchors," *Journal of Nondestructive Evaluation*, **29**: 49–61, DOI 10.1007/s10921-010-0065-5.
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C.2 Non-refereed Publications

C.2.(i) Papers in non-refereed conference proceedings and conference proceedings edited (it includes conference presentations for which papers were not required or not submitted)

- 45 Nasrollahi, A. and **Rizzo, P.** (2019). "On the use of nonlinear systems for nondestructive evaluation", ICoNSoM 2019, *International Conference on Nonlinear Solid Mechanics*, 16-19 June 2019, Rome (Italy), (Presentation and abstract only, Paper presented by P. Rizzo).
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- 43 Jalali, H., **Rizzo, P.** (2019). "Nonreciprocal propagation of acoustic waves in a granular chain coupled with asymmetric intruders", *SPIE Smart Structures/NDE 2019*, Denver, CO, USA, 3-7 March 2019. (Presentation and abstract only, Paper presented by Miss. Hoda Jalali).
- 42 Nasrollahi, A. and **Rizzo, P.** (2019). "Measuring axial stress in thick structures using highly nonlinear solitary waves", *SPIE Smart Structures/NDE 2019*, Denver, CO, USA, 3-7 March 2019. (Presentation and abstract only, Paper presented by P. Rizzo).
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C.2.(ii) Patents

- 3 Rizzo, P., and Nasrollahi, A. (2019). “Solitary wave-based trans-lid tonometer”, Provisional patent submitted on August 6, 2019.
- 2 Lanza di Scalea, F., Coccia, S., Bartoli, I., Salamone, S., and Rizzo, P. (2014). “Defect Detection In Objects Using Statistical Approaches,” *U.S. Patent 8,626,459 (date of patent 07 January 2014)*.
- 1 Daraio, C., and Rizzo, P., (2012). “Method and Apparatus for Nondestructive Evaluation and Monitoring of Materials and Structures,” *U.S. Patent 8,327,709 B2 (date of patent 11 December 2012)*.

C.2.(iii) Invited presentations

- 31 Rizzo, P. (2020). “Nonlinear solitary waves for the nondestructive evaluation of concrete”, *5th International conference on Structural Engineering and Concrete Technology (ICSECT'20)*, Lisbon (Portugal), April 19 - 21, 2020. **Keynote Lecture**. Due to COVID-19, this keynote was postponed to October 2020.
- 30 Rizzo, P. (2019). “Solitary waves along 1-D metamaterials for Nondestructive Evaluation Applications and Energy Harvesting”, University of Trento, Italy, 23 July 2019.
- 29 Rizzo, P. (2019). “On the use of nonlinear solitary waves for nondestructive evaluation applications”, University of California, San Diego, Department of Structural Engineering, La Jolla, CA, 15 February 2019.
- 28 Rizzo, P. (2018). “SCH: INT: Managing Glaucoma in the Digital Age: A New Tonometer to Connect Patients to their Caregivers”, NSF-Smart and Connected Health program, Connections in Smart Health Workshop, Arlington, VA, 24-26 September 2018.
- 27 Rizzo, P. (2018). “A Combined Monitoring Approach for Medical Implants”, *Monitoring Osseointegrated Program Review*, ONR-University at Buffalo, 16-17 May 2018.
- 26 Rizzo, P. (2018). “15 years of railroad research”, **Plenary Lecture** at the *Joint Rail Conference 2018*, 18 April 2018, Pittsburgh PA.
- 25 Rizzo, P. (2017). “A new nondestructive testing paradigm based on the use of nonlinear solitary waves”, Massachusetts Institute of Technology, Cambridge (MA), 11 October 2017.
- 24 Rizzo, P. (2016). “Leaky guided ultrasonic waves for the inspection of immersed structures”, Università di Napoli Federico II, Naples (Italy), 17 June 2016.
- 23 Rizzo, P. (2016). “The use of nonlinear solitary waves in structures and biomedical applications”, Politecnico di Milano, Milan (Italy), 13 June 2016.
- 22 Nasrollahi, A., Gulizzi, V., and **Rizzo, P.** (2016). “Smart Monitoring System Based on Electromechanical Impedance and Guided Ultrasonic Waves,” *Symposium P: Embodying Intelligence in Structures and Integrated Systems, CIMTEC 2016, 5th International Conference "Smart and Multifunctional Materials, Devices, Structures"*, Perugia, Italy, June 5-10, 2016.
- 21 Rizzo, P. (2015). “On the use of highly nonlinear solitary waves for nondestructive testing and energy harvesting”, Carnegie Mellon University, Pittsburgh, PA, October 23rd 2015.
- 20 Rizzo, P. (2015). “On the use of highly nonlinear solitary waves for nondestructive testing and energy harvesting”, Pennsylvania State University, State College, PA, October 7th 2015.
- 19 Rizzo, P. (2015). “NDE and structural health monitoring at the University of Pittsburgh, including: “Leaky guided ultrasonic waves for the inspection of immersed structures”, Vrije Universiteit Brussel, Brussels (Belgium), May 26th 2015.
- 18 Rizzo, P. (2015). “NDE and structural health monitoring at the University of Pittsburgh, including: “Leaky guided ultrasonic waves for the inspection of immersed structures”, University of Central Florida, Orlando, FL, February 5th 2015.
- 17 Rizzo, P. (2014). “Leaky guided ultrasonic waves for the inspection of immersed structures,” West Virginia University, Morgantown, WV, October 22nd, 2014.
- 16 Rizzo, P. (2013). “On the Use of Guided Ultrasonic Waves

- for the Inspection of Immersed Structures,” University of Michigan, Ann Arbor, Department of Civil and Environmental Engineering, Ann Arbor, MI, April 18th, 2013.
- 15 Rizzo, P. (2013). “On the Use of Guided Ultrasonic Waves for the Inspection of Immersed Structures,” NYU Tandon School of Engineering Polytechnic Institute, New York City, April 8th, 2013.
 - 14 Rizzo, P. (2012). “Use of Highly Nonlinear Solitary Waves for NDE and Structural Health Monitoring applications,” University of Arizona, Tucson, February 3rd 2012.
 - 13 Rizzo, P. (2011). “Inspection of Well-Pipes used in Unconventional Gas Sites,” The University of Pittsburgh, Wesley Eckenfelder Foundation, and the American Academy of Environmental Engineers, Pittsburgh, November 7, 2011.
 - 12 Rizzo, P. (2011). “Research Opportunities at the University of Pittsburgh’s Department of Civil and Environmental Engineering,” School of Engineering, University of Palermo, Italy, October 25, 2011.
 - 11 Rizzo, P. (2011). “The Electro-Mechanical Impedance Method,” Pennsylvania State University, State College, USA, April 12, 2011
 - 10 Rizzo, P. (2011). “From Sign Support Structure to Pipelines: a paradigm for the Health Monitoring of Tubular Structures,” Carnegie Mellon University, Pittsburgh, USA, February 25, 2011.
 - 9 Rizzo, P. (2009). “NDE and Structural Health Monitoring at the University of Pittsburgh: current researches and path forward,” Dipartimento di Chimica, Materiali e Ingegneria Chimica “G. Natta”, Politecnico di Milano, Italy, September 25, 2009.
 - 8 Rizzo, P. (2009). “NDE and Structural Health Monitoring at the University of Pittsburgh: current researches and path forward,” DISTART, University of Bologna, Italy, September 24, 2009.
 - 7 Rizzo, P. (2008). “Acoustic Emission for Civil Structures: two cases study,” Department of Civil Engineering, University of Miami, Miami, Florida, USA, November 2008.
 - 6 Rizzo, P. (2008). “NDE and Structural Health Monitoring at the University of Pittsburgh,” Department of Civil Engineering, Carnegie Mellon University, Pittsburgh, USA, October 10, 2008.
 - 5 Rizzo, P. (2008). “Acoustic emission for civil infrastructures,” Department of Structural and Geotechnical Engineering, University of Palermo, Italy, June 20, 2008.
 - 4 Rizzo, P. (2006). “Wavelet-based unsupervised and supervised learning algorithms for ultrasonic structural health monitoring”, University of California, Davis, Department of Civil and Environmental Engineering, January 30, 2006.
 - 3 Rizzo, P. (2006). “Wavelet-based unsupervised and supervised learning algorithms for ultrasonic structural health monitoring”, The Johns Hopkins University, Department of Civil Engineering, February 21, 2006.
 - 2 Rizzo, P. (2006). “Wavelet-based unsupervised and supervised learning algorithms for ultrasonic structural health monitoring”, Duke University, Department of Civil and Environmental Engineering, February 23, 2006.
 - 1 Rizzo, P. (2006). “Wavelet-based unsupervised and supervised learning algorithms for ultrasonic structural health monitoring”, University of Pittsburgh, Department of Civil and Environmental Engineering, March 22, 2006.

C.2.(iv) Technical Research Reports and Others.

- 24 **Rizzo, P.**, and Nasrollahi A. (2019). Advanced Neutral Temperature Estimation using Solitary Waves (ANTEUSW), Final Report submitted to the Transit IDEA Program Transportation Research Board National Research Council, Transit IDEA Project T-86.
- 23 **Rizzo, P.** (2016). Noninvasive Assessment of Existing Concrete, Final Report submitted to the Federal Railroad Administration under Contract No. 4400011482, Work Order No. PIT 008.
- 22 **Rizzo, P.**, and *Bagheri, A. (2014). Continued Investigation of Highly Nonlinear Solitary Waves for Rail Buckling Prevention, Final Report submitted to the Commonwealth Of Pennsylvania, Department of Transportation under Contract No. DTFR53-12-C-00014.
- 21 Matta, F., Velez, W., and Rizzo, P. (2014). *Corrosion Assessment of Tubular Steel Poles* – Final report submitted to CEATI International, CEATI REPORT No. T123700-3386.
- 20 T. Tang, S. Chen, G. Lederman, Z. Wang, H-Y, J. Bielak, J.H. Garrett Jr., P. Rizzo, F. Cerda, J. Kovacevic, (2014). “Feature analysis of temperature gradient effect on indirect and direct bridge SHM,” *Proc. of SPIE Smart Structures and Material& NDE and Health Monitoring, San Diego, CA, March 2014, Paper 9061-153*, Poster presentation.
- 19 Lanza di Scalea, F., Reynolds, F.M., Rizzo, P., Salamone, S., and Bartoli, I. (2013). “Research and Development to Demonstrate Ultrasonic Tomography Technology for Three-Dimensional Imaging of Internal Rail Flaws: Modeling and Simulation”, Final Report DOT/FRA/ORD-13/20.
- 18 **Rizzo, P.**, and Ochs, M.W. (2012). “Non-invasive Technology for the Assessment of Dental Implant Stability”, “*First Look*” *Technology Showcase*, University of Pittsburgh, 3 October 2012.
- 17 **Rizzo, P.** (2012). “Structural Health Monitoring of Civil Structures: New Methodologies and Field Applications 2012”, *Advances in Civil Engineering*, editorial.
- 16 Matta, F., Pierce, C., and Rizzo, P. (2011). *New Structural Materials for Transmission Lines* – Final report submitted to CEATI International, Project # T103700-3370.
- 15 Matta, F., Pierce, C., and Rizzo, P. (2011). *Review of Traditional Structural Materials for Overhead Transmission Lines* – Progress report submitted to CEATI International, Project # T103700-3370.
- 14 *Werntges, P., *Pistone, E., and **Rizzo, P.**, (2011). “NDE of Immersed Metallic Plates by Guided and Interface Ultrasonic Waves,” *Proceedings of SPIE’s 18th Annual International Symposium on Smart Structures and Materials* –Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems 2010, Poster presentation.
- 13 **Rizzo, P.** (2010). “Special Issue on Structural Health Monitoring for Civil Structures: From the Lab to the Field”, *Advances in Civil Engineering*, editorial.
- 12 **Rizzo, P.**, and *Zhu, P. (2010). *Sensing Technology for Damage Assessment of Sign Supports and Cantilever Poles – Final Report No. , FHWA – PA – 2010 -10 – PIT008*University of Pittsburgh.
- 11 *Zhu, P., **Rizzo, P.**, and *Tajari, M. (2010). *Sensing Technology for Damage Assessment of Sign Supports and Cantilever Poles – Task 4, Year 2 Report*, Pennsylvania Department of Transportation, Contract No. 519691-PIT 008, University of Pittsburgh.
- 10 *Kacin, J., **Rizzo, P.**, and *Annamdas, V.G.M. (2009). *Sensing Technology for Damage Assessment of Sign Supports and Cantilever Poles – Tasks 2-3, Year 1 Report*, Pennsylvania Department of Transportation, Contract No. 519691-PIT 008, University

- of Pittsburgh.
- 9 **Rizzo, P.**, *Annamdas, V.G.M., and Kacin, J., (2008). *Sensing Technology for Damage Assessment of Sign Supports and Cantilever Poles – Task 1*, Draft Interim Report, Pennsylvania Department of Transportation, Contract No. 519691-PIT 008, University of Pittsburgh.
 - 8 Coccia, S., Bartoli, I., Lanza di Scalea, F., and Rizzo, P., (2007). *Non-contact Rail Defect Detection: First and Second Field Tests*, Technical Report No. SSRP-07/15, University of California, San Diego.
 - 7 Rizzo, P., Coccia, S., Bartoli, I., and Lanza di Scalea, F., (2006). *On line High-Speed Rail Defect Detection – Prototype Assembling and Field Testing*, Technical Report No. SSRP-06/17, University of California, San Diego.
 - 6 Rizzo, P., Coccia, S., and Lanza di Scalea, F., (2005). *On line High-Speed Rail Defect Detection, Final Report-Phase III*, Technical Report No. SSRP-05/04, University of California, San Diego.
 - 5 Marzani, A., and Rizzo, P., (2005). “Sull’ispezione non distruttiva di sistemi di condotte metalliche”, *Rassegna del CTA*, Anno III, No. 6-7, (in Italian).
 - 4 Lanza di Scalea, F., Bartoli, I., Rizzo, P., and McNamara, J., (2004). *On line High-Speed Rail Defect Detection, Final Report-Part 1*, DOT/FRA/ORD-04/16.
 - 3 Rizzo, P., (2004). *Health Monitoring of Tendons and Stay Cables for Civil Structures*. PhD Dissertation.
 - 2 Rizzo, P., Lanza di Scalea, F., Karbhari, V.M., and Seible F., (2001). *Acoustic Emission Monitoring of CFRP Stay Cables During Proof Testing*, Technical Report SSRP-2001/03, University of California, San Diego.
 - 1 Rizzo, P., (1998). *Finite Element Analysis of Laminate Composite Panels with High-Order Mixed Formulation*. Laurea Thesis, University of Palermo, Italy. (in Italian).

D) Funded Research Proposals

D.1. EXTERNAL PEER REVIEWED (sorted by the most recent award)

Project Title: SCH: INT: Managing Glaucoma in the Digital Age: A New Tonometer to Connect Patients to their Caregivers.

Funding Agency: **National Science Foundation**

Project Duration: 4 years.

Level of Support: 1,099,984.

Principal Investigator: **Rizzo. Co-PI: Dickerson (ECE), Conner and Sigal (Pitt – Eye Center), Handzel (UPMC).**

Funded Period: September 1, 2020 - August 31, 2024

Summary: In this project, we propose to develop an off-the-counter home tonometer to perform self-measurements of the intraocular pressure using an engineering principle, the propagation of solitary waves, never explored in ophthalmology. This new tonometer would connect remotely glaucoma patients to their eye-care providers via smartphone and a Web-based App, interfaced with the patients' electronic health record (EHR). If the hypothesis will be validated, the new device will allow the self-measurement of the intraocular pressure (IOP) anywhere anytime at the patients' convenience, without the burden of clinical visits. The new tonometer is based on the dynamical interaction between the highly nonlinear solitary waves (HNSWs) propagating within a chain of a few mm particles, embedded in the instrument, and the eye to be evaluated and in point-contact with the tip of the instrument (one end of the chain). The instrument will contain: (1) a trigger to induce the waves; (2) a short chain with an internal sensor to measure the waves; (3) a programmable hardware to link the waves' features to the IOP; (4) Bluetooth technology to communicate with smartphones; (5) an App to chart the IOP data on the smartphone and to interface with the patient's EHR for direct access by the eye-care professionals.

Project Title: Image Processing and Machine Learning Algorithms to Measure Axial Stress in Rails (Phase II).

Funding Agency: **Federal Railroad Administration**

Project Duration: 30 months.

Level of Support: \$ 177,297.00

Principal Investigator: **Rizzo. Co-PI: Dr. Hao Sun, Northeastern University**

Funded Period: 07/29/20 – 07/28/2022

Summary: See Phase I.

Project Title: In-motion Track Stability Assessment using a High-resolution Camera.

Funding Agency: **American Association of Railroads: RFP 2019 Strategic Research – Grand Challenges in Railroad Technology (Year 1)**

Project Duration: 6 months.

Level of Support: \$87,500.

Principal Investigator: **Rizzo. Co-PI: Dr. Hao Sun, Northeastern University**

Funded Period: 06/01/20 – 12/31/2020

Summary: We propose an innovative approach to assess the stability of continuous welded rails (CWRs) by measuring the axial stress in CWRs without prior knowledge of the rail neutral temperature (RNT), without the need for daylong observations under favorable weather, and without unfastening a long portion of the rail track. The method, which has the potential to be installed in a moving vehicle, is based on the non-contact detection of rail vibrations using a high-speed high-resolution camera and on machine learning algorithms to associate those vibrations to the stress.

Project Title: An integrated NDT system to characterize rocks

Funding Agency: American Society for Nondestructive Testing – 2020 Fellowship Award

Project Duration: 18 months.

Level of Support: \$20,000

Principal Investigator: **Rizzo (this is a fellowship grant given to a student, Mr. Yuhi Zeng), Dr. Andrew Bungler (Co-PI)**

Funded Period: 07/01/20 – 12/31/21

Summary: The goal of this ASNT Fellowship Award is to characterize the anisotropic properties of rocks using a dual complementary nondestructive testing approach based on immersion ultrasound and solitary waves. Immersion ultrasound has roots in nondestructive testing of large components and was adopted by Dr. Rizzo to detect damage in large aluminum plates using guided waves. The method based on solitary waves will be an expansion of a method co-invented by Dr. Rizzo who applied such method for the non-destructive characterization and damage detection of some engineering materials and structures. The project will set the foundation of a new apparatus to estimate the full mechanical characteristics of transversely isotropic rocks by exploiting the propagation of longitudinal, shear and Scholte waves in immersed samples, and by exploiting the characteristics of solitary waves propagating in a periodic array of spherical particles in contact with the rock to be characterized. The project entails the testing of progressively smaller (from 20 mm to 2 mm) cylindrical specimens in order to firstly establish scalability of the two approaches, and the development of simplified models to correlate solitary wave features (amplitude and speed) to rock strength and modulus. The long-term goal is the development of a low cost easy-to-use dual NDT method of valuable interest for many industries.

Project Title: Image Processing and Machine Learning Algorithms to Measure Axial Stress in Rails.

Funding Agency: **Federal Railroad Administration**

Project Duration: 30 months.

Level of Support: \$ 154,589.00

Principal Investigator: **Rizzo. Co-PI: Dr. Hao Sun, Northeastern University**

Funded Period: 07/29/19 – 01/28/2022

Summary: We propose a NDE method based on the non-contact detection of lateral and transverse rail vibrations using cameras operating at ~1,000 frames per second (fps). The overall idea is to trigger lateral and transverse vibrations with a hammer. These vibrations are observed with a camera and the video recordings are processed with image processing algorithms able to extract characteristics such as mode-shapes and frequencies. These characteristics are then used to infer the axial stress σ_R using existing models and advanced machine learning algorithms being developed in this project.

Project Title: Nonlinear solitary waves for the detection of corrosion at any temperature

Funding Agency: American Society for Nondestructive Testing – 2019 Fellowship Award

Project Duration: 18 months.

Level of Support: \$20,000

Principal Investigator: **Rizzo (this is a fellowship grant given to a student, Miss Hoda Jalali)**

Funded Period: 07/01/19 – 12/31/20

Summary: In this ASNT Fellowship Award, A new nondestructive testing/structural health monitoring (NDT/SHM) paradigm for metallic structures prone to erosion/corrosion is proposed. The paradigm exploits the propagation of highly nonlinear solitary waves (HNSWs) along 1-D chains of spherical particles in a dry contact point with the metal to be inspected. The principle of the proposed paradigm is quite simple, though effective. One end of the chain is in dry-contact with the metal; a solitary pulse is excited at the opposite end of the chain and reaches the chain/metal interface. At this contact point, the solitary pulse is partially reflected back and partially triggers a second pulse that is

reflected back to the chain with some time delay with respect to the primary reflection. In this ASNT Graduate Fellowship, the hypothesis that the thickness of the metallic structure influences monotonically the amplitude and time of flight of the two reflected pulses will be investigated numerically and experimentally. If the research hypotheses will be proven, the proposed new NDT/SHM method will have the following advantages with respect to conventional thickness measurement systems based on sonic and ultrasonic systems: 1) economically convenient; 2) applicable at high-temperature; 3) suitable for structural health monitoring approach.

Project Title: A Solitary Waves Based Transducer For Engineering And Biomedical Applications.

Funding Agency: **National Science Foundation**

Project Duration: 36 months.

Level of Support: \$ 360,000.00

Principal Investigator: **Rizzo**

Co-Principal Investigator: Sam Dickerson (ECE, Pitt), Ian Conner (UPMC, Eye Center)

Funded Period: August 2018 – July 2021.

Summary: In petrochemical and nuclear power plants, aging pipelines and harsh environment call for advanced methodologies to monitor the intricate network of piping in order to prevent catastrophic explosions. Flow-accelerated corrosion and erosion-corrosion are among the most common degradation modes of the steel piping. One of the maintenance paradigms to mitigate the risks of structural failures consists of measuring the thickness of pipe walls periodically, at predefined locations using conventional nondestructive evaluation methods. However, this maintenance strategy can do little when flaws are induced or become critical between two maintenance inspections. In addition, the intricate network of pipes, some of which operating at very high temperature, makes periodic inspection neither trivial nor inexpensive.

In this project, we propose a new transduction mechanism that can be used to monitor continuously the pipes of interests. The transducer consists of four main components: a chain of a few millimeter spherical particles able to sustain the propagation of highly nonlinear solitary waves; a mechanism to trigger the waves in the chain; an embedded sensor to detect the waves; a hardware system to process in-situ the data and transmit valuable information wirelessly. The research hypothesis is that certain characteristics of the waves are dependent on the thickness of the pipe. If the hypothesis will be validated, the new transducer will allow the continuous monitoring of the structure of interest without plant shutdown, and will not suffer from data fidelity due to high-temperature operation or variability associated with coupling mechanism. Ultimately, the proposed transducer shall enable the remote measurement of the wall thickness of pipes operating at any temperature and at any location, above and below ground. While studying the fundamental principles of this new transducer to address the engineering problem of pipe bursts, the investigators will explore the feasibility of the transducer, opportunely downscaled and designed, at measuring the intraocular pressure of the human eye. The objective is to allow glaucoma patients to perform frequent self-measurement of their intraocular pressure without the burden of clinical visits. This will benefit the millions of patients that suffer from glaucoma, an age-related disease and the second leading cause of blindness in the world. To this end, this project represents the initial step towards the development of a new portable tonometer for self-measurements to allow glaucoma patients capturing the spontaneous circadian rhythm of the eye pressure. The two main technological innovations that are expected from the scientific advancements of this project are: (1) a new transducer for the remote measurement of metallic pipe thickness operating at any temperature and at any location; and (2) a new trans-palpebral tonometer to perform self-measurements anywhere anytime.

Project Title: EAGER: Acoustic Diode as Architectural Material (ADAM).

Funding Agency: **National Science Foundation**

Project Duration: 24 months.

Level of Support: \$ 200,000.00

Principal Investigator: **Rizzo**

Funded Period: August 2017 – July 2019.

Summary: Acoustic noise is the slyest form of pollution because its effects on the human health are underestimated. Exposure to noise may hamper the nervous system, trigger stress and sleep disorder, and may cause heart problems and high blood pressure. People are exposed to noise almost anywhere. For this reason engineers and architects strive to create effective and fine solutions to mitigate indoor-generated noise in order to enhance the comfort of the occupants, improve personnel efficiency in the workplace, guarantee privacy, and to provide distraction-free spaces. With this societal problem in mind, this research will explore a new architectural system, based on the concept of acoustic diode acting as a sound barrier. The outcome of this EAGER will enable to carry out a comprehensive study that will address a societal issue that impacts a large fraction of the human population. Additionally, the project will be of interest for architectural and structural engineering, and will be impactful in many ways including the: (1) the cross-pollination of a few different disciplines such as acoustics, nonlinear dynamics, and architectural engineering; (2) supervision of a diverse pool of students with skills in computation and experimentation; (3) integration of the research findings into a multidisciplinary education program to engage senior undergraduates, professional M.S. and graduate students; (4) outreach and dissemination activities to inform the academic community, professional engineers, professionals and some general young audience of the economic and societal impacts of designing better acoustic barriers using the novel concepts of acoustic metamaterials.

Project Title: Advanced Neutral Temperature Estimation using Solitary Waves (ANTEUSW).

Funding Agency: **TRB Transit Idea Program**

Project Duration: 18 months.

Level of Support: \$ 99,994.00 (+ \$ 51,391 cost sharing)

Principal Investigator: **Rizzo**

Funded Period: 05/01/17 – 10/31/18

Summary: We propose a new NDE method to determine the RNT and the axial stress of CWRs. The method consists on the propagation of solitary waves (SWs) within a chain in contact with the rail. The hypothesis is that the stress in the rail influences the amplitude and speed of the SWs propagating within the chain. The project outcome will be a new NDE that can provide the necessary level of accuracy with minimum traffic disruption, and with a few measurements that do not require day-long observations under favorable weather, and without permanent wayside installations. This Type 1 project will prove the concept of an innovation that shall prevent sun kinks or rail fracture. The project fits the mission of the Transit IDEA Program as it addresses the four high-priority focus areas set by the Program.

Project Title: Automated Rail Head Internal Flaw Characterization Using Phased Array Systems

Funding Agency: **Federal Railroad Administration**

Project Duration: 24 months.

Level of Support: \$65,000 to Rizzo (\$300,000 total)

Principal Investigator: **PZFlex** (lead); **EWI** and **Rizzo** as co-PI

Funded Period: 02/01/17 – 01/31/19

Summary: The main objective of the proposed effort is to develop an automated rail head internal flaw characterization and sizing technology, based on phased array (PA) ultrasonic inspections. The automated internal defect characterization will effectively shift the burden on flaw size estimation off of the field inspector and on to the data analysis and software development.

Project Title: Metamaterials for sports engineering and path forward (REU supplement to the project: COLLABORATIVE RESEARCH: Highly nonlinear transducer arrays for structural health monitoring

Funding Agency: **National Science Foundation**

Project Duration: 36 months.

Level of Support: \$4,800

Principal Investigator: **Rizzo**

Funded Period: 09/01/15 – 08/31/16

Summary: REU project as a supplement to the NSF project: COLLABORATIVE RESEARCH: Highly nonlinear transducer arrays for structural health monitoring.

Project Title: Merging guided ultrasonic waves and electromechanical impedance: a novel NDT paradigm

Funding Agency: **American Society for Nondestructive Testing – 2015 Fellowship Award**

Project Duration: 18 months.

Level of Support: \$20,000

Principal Investigator: **Rizzo (this is a fellowship grant to support one graduate student)**

Funded Period: 07/01/15 – 12/31/16

Summary: In this ASNT Fellowship Award, a new NDT paradigm for any civil or aerospace structure that can support the propagation of the guided ultrasonic waves (GUWs) and that can interact mechanically with wafer-type transducers is proposed. The NDT paradigm consists of one or multiple arrays of sensors bonded or embedded to the structure of interest with the purpose of simultaneously measure the electromechanical impedance (EMI) of the sensor-structure system and sense the GUWs emitted and detected by the same transducers. The GUW approach is exploited according to the pitch-catch and the pulse-echo configuration. The vision is an NDT method that uses simultaneously three nondestructive techniques by using a unified sensing system. The research hypothesis of this “3 in 1” paradigm is that the novel paradigm: 1) provides a reliable and redundant methodology for the SHM of structural waveguides of any shape and complexity; 2) is able to detect and monitor damage onset and progression at structural “hot spots”; 3) enhances the advantages and nullifies the limitations of the three approaches applied individually.

Project Title: Continued Investigation of Highly Nonlinear Solitary Waves for Rail Buckling Prevention

Funding Agency: **Federal Railroad Administration**

Project Duration: 12 months.

Level of Support: \$68,415

Principal Investigator: **Rizzo** (Sole investigator).

Funded Period: 08/01/13 – 07/31/14

Summary: This is the year 2 of the project titled “Highly Nonlinear Solitary Waves for Rail Buckling Prevention”.

Project Title: COLLABORATIVE RESEARCH: Highly nonlinear transducer arrays for structural health monitoring

Funding Agency: **National Science Foundation**

Project Duration: 36 months.

Level of Support: \$239,971

Principal Investigator: **Rizzo**

Funded Period: 09/01/12 – 08/31/15

Summary: We propose to study the fundamental properties and applications of novel arrays of nonlinear actuators for the nondestructive evaluation (NDE) and structural health monitoring (SHM) of civil structures and materials. We will also investigate the ability to use the nonlinear actuators for focusing and harvesting elastic energy, and for imaging bulk materials. The arrays of nonlinear actuators included in this study can generate highly nonlinear solitary waves (HNSWs), which are compact non-dispersive stress waves with a finite spatial dimension. The spatial dimension of these pulses is independent of the wave amplitude and dependent only on the nonlinear material’s geometry. HNSWs hold promise to improve current NDE/SHM devices because of their ability to support non-oscillatory, high amplitude signals that rely exclusively on mechanical excitations. On a

fundamental level, we aim at understanding the behavior of arrays of highly nonlinear actuators adjacent to different neighboring solid media. In particular, we will: (i) study the ability to focus nonlinear waves as a function of the properties of the adjacent media, (ii) design and implement methods to improve transmission of the signal across the interface between the actuators and the adjacent media; (iii) determine the limitations of signal power and the degradation of performance due to failure of the highly nonlinear actuators. From a purely applied perspective, the project will be devoted to the application of HNSWs for the NDE/SHM of structural materials.

Project Title: Corrosion Assessment of Tubular Steel Poles

Funding Agency: **Center for Energy Advancement through Technological Innovation (CEATI)**

Project Duration: 12 months.

Level of Support: \$93,696 total (\$18,093 to Pitt)

Principal Investigator: **F. Matta (University of South Carolina). Rizzo as a co-PI**

Funded Period: 09/01/12 – 08/31/13

Summary: The objective of the proposed project is to critically evaluate: a) promising measurement methods and NDE techniques to characterize corrosion in tubular steel poles near and below the ground line; and b) analytical methodologies to predict steel loss based on available data from the aforementioned techniques, and from data on type and characteristics of the soil, and steel composition and coating characteristics. The proponents emphasize that the evaluation of prediction methodologies is as important as that of the measurement and NDE methods, since it is aimed at providing key input data for the interested utilities' decision making process.

The overarching goal is to provide the technical background to gather reliable information to make informed decision and prioritize corrosion repair and rehabilitation operations. The tangible outcome will be the efficient prevention of costly outages due to steel pole failures, and the rationalization/prioritization of the inspection and intervention costs.

Project Title: Highly Nonlinear Solitary Waves for Rail Buckling Prevention

Funding Agency: **Federal Railroad Administration**

Project Duration: 12 months.

Level of Support: \$72,586

Principal Investigator: **Rizzo** (Sole investigator).

Funded Period: 04/01/12 – 03/31/13

Summary: One of the major problems in the railroad networks that consist of continuous welded rails is buckling in hot weather and breakage or pulling apart in cold weather. To prevent these accidents, a reliable nondestructive methodology able to determine thermal stress or the rail neutral temperature (NT), defined as the temperature at which the net longitudinal force in the rail is zero, would be ideal. Unfortunately, the measurement of the in situ stress or alternatively of the NT has been a long-standing challenge. In this seed funding research project, we propose to develop a sensing system able to indirectly measure applied stress in rails both in the head and in the web. The system consists of a simple and cost-effective transducer able to generate and detect highly nonlinear solitary waves (HNSWs), which are compact non-dispersive stress waves that can form and travel in highly nonlinear systems such as granular, layered, or porous materials.

Project Title: Indirect Bridge Health Monitoring Using Moving Vehicles

Funding Agency: National Science Foundation

Project Duration: 36 months.

Level of Support: \$670,461 (\$57,080 to Dr. Rizzo at Pitt)

Principal Investigator: **Rizzo as co-PI.** Carnegie Mellon University (Profs. Bielak, Garrett, and Kovacevic) as leading institution.

Funded Period: 09/01/11 – 08/31/14

Summary: We propose a new approach that combines the advantages of a robust SHM paradigm with the advantages of decentralizing the monitoring apparatus to fleets of vehicles that can continuously store or send data. The objective is to provide accurate, rapid, nearly continuous, and cost-effective assessments of a large population of bridges. The new methodology envisions a set of moving vehicles equipped with sensors (which most of them already possess) able to capture the dynamic interaction between the vehicles and the bridge. As this interaction depends also on the modal characteristics of the bridge, we hypothesize that changes in the dynamic interaction can allow inference of damage-related features of the bridge. The methodology couples the sensing system to multiresolution (MR) signal processing and pattern recognition algorithms to capture, locate, and classify variations in the bridges' structural dynamic properties, such as resonant frequencies, mode shapes, or localized stiffness.

Project Title: Hazard Mitigation of Water Mains by Means of Immersed Active/Passive Inspection Systems

Funding Agency: National Science Foundation

Project Duration: 36 months.

Level of Support: \$300,000

Principal Investigator: **Rizzo**

Funded Period: 09/01/10 – 08/31/13

Summary: We propose to develop a hybrid laser/immersion transducers system for the nondestructive inspection of freshwater mains as well as underwater structures. The research aims to detect normally invisible cracks on the interior walls of the underground mains that initiate disruptions in the water supply systems causing widespread distress in local communities and businesses. The crack detection concept is based on the hypothesis that underwater laser pulses are able to generate stress waves along the axial and the circumferential directions of the pipe that can be detected by an array of immersion transducers devoted to the detection of these stress waves. It is proposed to collect adequate data to provide full pipeline coverage along the pipe length to minimize false positives/negatives. The project will develop a trenchless technology with the design of a prototype that may be used on an underwater vehicle to inspect pipes from the inside without service disruption. These goals shall be accomplished by using guided ultrasonic waves generated and detected from inside the pipe using non contact methods and advanced digital signal processing of the generated and detected wave data to detect crack anomalies underneath the interior walls of the pipes. Besides the importance of the research results to the scientific community, the proposed research will have a significant impact on the inspection approaches that are used for underwater structures in civil and military applications as the system proposed to inspect freshwater mains from the inside can be also employed to monitor large underwater structures. This research will provide multidisciplinary and advanced education and training to students participating in the project.

Project Title: New Structural Materials for Transmission Lines

Funding Agency: Center for Energy Advancement through Technological Innovation (CEATI)

Project Duration: 12 months.

Level of Support: \$40,000 total (\$10,010 to Pitt)

Principal Investigator: **F. Matta (University of South Carolina). Rizzo as a co-PI**

Funded Period: 10/01/10 – 06/30/11

Summary: We propose to produce a comprehensive and critical review of materials presently used in transmission line structures, and of emerging materials that have the potential to be more cost-effectively deployed in transmission lines structures. Representative examples include materials essentially ready for implementation (such as fiber reinforced polymers and controlled low-strength materials), systems under development (such as concrete shells with non-corrosive composite reinforcement, inorganic matrix composites), to others for which research is in its infancy or still far from technology transfer (such as cement-based nanocomposites). To credibly portray the potential for actual deployment and the in-service costs associated with the emerging materials examined, the

proposed review covers suitable inspection and monitoring technologies and practices, as well as design and construction guidelines and standards.

Project Title: CCLI Type 1: Integrating Sustainability into the Civil Engineering Curriculum Through Three Courses

Funding Agency: National Science Foundation

Project Duration: 24 months.

Level of Support: \$199,982

Principal Investigator: **A. Landis (PI), M. Bilec and P. Rizzo as co-PIs (all from Pitt)**

Submission date: 7/01/10 – 06/30/12

Summary: The goal of the project is to infuse sustainability concepts into three civil engineering courses using experiential learning. The project is involving students in research-quality and service learning experiences and in engaging laboratory activities both in the classroom and in the real-world. In addition, it is reaching middle school and high school students and teachers and residents in low income communities through ongoing programs. The evaluation effort, with assistance from an on-campus center for instructional development, is using on-line student and faculty surveys, analysis of student products, and direct observations to monitor progress. Dissemination is being accomplished through postings on websites and through conference and journal publications. Broader impacts include the dissemination of the material, the K-12 outreach, and the interaction with the community through the service learning component.

Project Title: COLLABORATIVE RESEARCH: Novel NDE/SHM approach based on highly nonlinear dynamics (Dear Colleague Letter to support diversity)

Funding Agency: National Science Foundation

Project Duration: 36 months.

Level of Support: \$45,250

Principal Investigator: **Rizzo**

Funded Period: 09/01/08 – 08/31/11

Summary: This GRS will support a graduate student with disabilities to conduct research in the area of nondestructive evaluation/structural health monitoring and specifically in the framework of the active NSF project: 0825983 COLLABORATIVE RESEARCH: Novel NDE/SHM approach based on highly nonlinear dynamics. The research objective of the NSF project is the development of a new paradigm for Non Destructive Evaluation and Structural Health Monitoring (NDE/SHM) of materials and structures based on Highly Nonlinear Solitary Waves (HNSWs). The project aims at: a) understanding the coupling between a highly nonlinear oscillators and linear structures; b) detecting defects across scales: from the nanometer to the macroscopic level; c) evaluating applied stress in a given system; d) characterizing the mechanical properties of materials tailoring the pulse properties during propagation (inverse approach), and e) designing new, and therefore patentable, actuators/sensors technology for stress wave generation and detection.

Project Title: Newton's cradle: a toy or an acoustic filter? (REU supplement to the project: COLLABORATIVE RESEARCH: Novel NDE/SHM approach based on highly nonlinear dynamics)

Funding Agency: National Science Foundation

Project Duration: 36 months.

Level of Support: \$6,000

Principal Investigator: **Rizzo**

Funded Period: 09/01/08 – 08/31/11

Summary: REU project as a supplement to the NSF project: 0825983 COLLABORATIVE RESEARCH: Novel NDE/SHM approach based on highly nonlinear dynamics.

Project Title: Highly Nonlinear Solitary Waves for NDT of Civil Structures

Funding Agency: American Society for Nondestructive Testing – 2009 Fellowship Award

Project Duration: 12 months.

Level of Support: \$15,000

Principal Investigator: **Rizzo (this is a fellowship grant to support one graduate student)**

Funded Period: 08/01/07 – 07/30/08

Summary: The proposed research aims at creating a new paradigm for NDT of structural materials based on the generation and propagation of Highly Nonlinear Solitary Waves (HNSWs). HNSWs are stress waves that can form and travel in highly nonlinear systems (i.e. granular, layered, fibrous or porous materials) with a finite spatial dimension that is independent on the wave amplitude and dependent only on the material's geometry. The generation of HNSWs does not rely on the use of electronic equipment (such as an arbitrary function generator) and on the response of piezoelectric crystals or other transduction mechanism. In addition, HNSWs offer a natural versatility (tunability) in terms of choice of wavelength, speed, amplitude, and repetition rate. The choice can be achieved by a simple and reproducible experimental setup adaptable to each specific application.

In this project the tunability of the solitary waves' properties will be exploited to develop a novel NDT paradigm in which the HNSWs are used as the input waveforms (exciters) and a similar set up can be also used to analyze the output (receivers). In addition, by relaxing the need for the power requirements (function generators) the approach may facilitate the transition from tethered to wireless technology.

Project Title: COLLABORATIVE RESEARCH: Novel NDE/SHM approach based on highly nonlinear dynamics

Funding Agency: National Science Foundation

Project Duration: 36 months.

Level of Support: \$220,000

Principal Investigator: **Rizzo (Pitt) and C. Daraio (California Institute of Technology)**

Funded Period: 09/01/08 – 08/31/11

Summary: We propose to create a new paradigm for Non Destructive Evaluation and Structural Health Monitoring (NDE/SHM) of materials and structures based on Highly Nonlinear Solitary Waves (HNSWs). The proposed research leverages on the tunability provided by highly nonlinear systems to open up a new field of theoretical and experimental investigations aimed at: a) understanding the coupling between a highly nonlinear oscillators and linear structures; b) detecting defects across scales: from the micro- to the macro-scopic level; c) evaluating applied stress in a given system; d) characterizing the mechanical properties of materials tailoring the pulse properties during propagation (inverse approach) aided by numerical modeling, and e) designing new, and therefore patentable, actuators/sensors technology for stress wave generation and detection. In the last two decades researches and applications of elastic stress waves (both in the sonic and ultrasonic range) for NDE/SHM have thrived owing to their capability of assessing the elastic properties of materials and the presence of damage. The recent discovery and development of the highly nonlinear wave theory and its numerical and experimental validation offer a new tool to the NDE/SHM community. The soundness of engineering systems is essential to avoid catastrophic failures that may be accompanied by severe consequences for the environment, can lead to the loss of human life, and produce tonnage of demolition waste. It is therefore of paramount importance to the nation's sustainability, economy growth and safety that NDE/SHM, to be able to accurately detect defects at early stages or to characterize the mechanical properties of a given structure. With the proposed research we plan to delve in the fundamental understanding of highly nonlinear waves coupling with materials and structures, offering a direct opportunity to transfer the technology in viable commercial applications much improved over the state-of-the-art actuating/sensing technology for NDE/SHM.

Project Title: Development of Undergraduate Course CEE1370 "Nondestructive Evaluation

Funding Agency: American Society for Nondestructive Testing – 2007 Faculty Grant Award

Project Duration: 12 months.

Level of Support: \$8,000

Principal Investigator: **Rizzo**

Funded Period: 08/01/07 – 07/30/08

Summary: This 2007 ASNT Faculty Award aimed at the development of a new course in Non-Destructive Evaluation (NDE) within the undergraduate Civil and Environmental Engineering (CEE) curriculum at the University of Pittsburgh (PITT).

D.2. EXTERNAL NON-PEER REVIEWED

Project Title: In-motion Track Stability Assessment using a High-resolution Camera (Supplement awarded to UPitt).

Funding Agency: **American Association of Railroads: RFP 2019 Strategic Research – Grand Challenges in Railroad Technology**

Project Duration: N/A Supplement to year 2020 funding.

Level of Support: \$22,000.

Principal Investigator: **Rizzo. Co-PI: Dr. Hao Sun, Northeastern University**

Funded Period: N/A

Summary: Supplemental funding to purchase a camera and a PC.

Project Title: EWSHM 2020 Student Travel Grant. To Be Held in Palermo, Italy, July 6-9, 2020

Funding Agency: National Science Foundation

Project Duration: 18 months.

Level of Support: \$10,000

Principal Investigator: **Rizzo.**

Funded Period: 05/01/20 – 12/31/21

Summary: This Travel Proposal is to request fund to support a certain number of five graduate or undergraduate students from U.S. Institutions in order to attend the 10th European Workshop on Structural Health Monitoring (EWSHM 2020), to be held in Palermo (Italy) on July 6-9, 2020. Preference will be given to underrepresented groups.

Project Title: Data Management, Mining, and Inference for Bridge Monitoring

Funding Agency: Pennsylvania Department of Transportation

Project Duration: 46 months.

Level of Support: \$361,833

Principal Investigator: **Rizzo.**

Funded Period: 01/01/20 – 10/31/23

Summary: The overall objective of the project is to investigate advanced data management, analysis, mining and inference approaches for bridge health monitoring, safety evaluation, reliability and resilience assessment of instrumented bridges in Pennsylvania.

Project Title: In-motion Track Stability Assessment using a High-resolution Camera

Funding Agency: Transportation Technology Center, Inc.

Project Duration: 2 months.

Level of Support: \$16,000

Principal Investigator: **Rizzo.**

Funded Period: 11/10/19 – 12/31/19

Summary: We propose an innovative approach to assess the stability of continuous welded rails (CWRs). The approach is based on the estimation of the axial stress in CWRs without prior

knowledge of the rail neutral temperature (RNT), without the need for daylong observations under favorable weather, and without unfastening a long portion of the rail track. The method is based on the non-contact detection of rail vibrations using a high-speed high-resolution camera. The overall idea is to trigger lateral and (if necessary) transverse vibrations with a hammer. These vibrations are recorded with the camera and post-processed with an image processing algorithm able to extract the modal characteristics of the rail, such as mode-shapes and frequencies. These characteristics are then used to infer the axial stress of the rail by comparing the field data to a finite element model and by feeding the field data to a machine learning algorithm trained with experimental and finite element data. With this project, \$16,000 are requested to purchase a high-speed, high-resolution camera to perform a series of experiments at UPitt.

Project Title: Noninvasive assessment of existing concrete

Funding Agency: Pennsylvania Department of Transportation

Project Duration: 12 months.

Level of Support: \$132,035

Principal Investigator: **Rizzo**. Co-PI: Vandebossche and Magalotti (both at Pitt)

Funded Period: 02/01/15 – 01/31/16

Summary: The overall objective of the project is to test the capability of a novel sensing device for the determination of strength of concrete and for the prediction of the compressive strength of existing concrete in bridge decks. The sensing device is based on the generation and detection of highly nonlinear solitary waves (HNSWs), which are stress waves that can form and travel in highly nonlinear systems such as chains of spherical particles. Simultaneously a conventional ultrasonic method based on pitch-catch and pulse-echo will be used. Both methods will test cured concrete cylinders and slabs built at the University of Pittsburgh.

The research hypothesis is that the HNSW-based technique or the ultrasonic technique or both are able to determine the modulus of concrete, which might have been compromised by environmental factors or accidental damage. By knowing the modulus of concrete, the ultimate strength of the concrete itself may be derived.

Project Title: Sensing Technology for Damage Assessment of Sign Supports and Cantilever Poles Structures

Funding Agency: Pennsylvania Department of Transportation

Project Duration: 36 months.

Level of Support: \$346,143

Principal Investigator: **Rizzo (sole investigator)**

Funded Period: 03/01/08 – 08/31/10

Summary: The objective of this work is to develop and deploy a robust and low-cost sensing technology to assess the structural soundness of sign supports, cantilever poles, and variable message sign supports. An analytical model will be initially developed to correlate stress-crack severity and/or location to their structural integrity and residual lifetime. Thus, the sensing technology, by detecting location and size of any defect, will provide a mean for PennDOT to predict the residual lifetime and to establish the need for replacement or retrofit.

The proposed activities will include efforts in the following areas: finite element modeling, nondestructive evaluation (NDE), structural health monitoring (SHM), fatigue life prediction, and sensor technology development. The project will quantify the dynamic characteristics of in-service structures analytically, and will investigate the effect on the residual structures' life of stress-cracks located at critical elements. An effective NDE/SHM system will be proposed and developed. Fatigue tests will be performed at the Watkins-Haggart laboratories to validate the analytical model and the NDE/SHM approach. Simultaneously, the system will be tested in the field at locations determined by PennDOT to obtain actual field condition information. The impact of this work on the transportation industry lies on the implementation of a cost-effective strategy that will prevent structural failures that may lead to catastrophic collapses. In addition, the early detection of damage will allow stopping further damage propagation and will prolong the structure's lifetime by taking appropriate remedial actions such as repair or retrofit.

D.3. INTERNAL PEER REVIEWED

Project Title: Travel Grant: Attending the ICoNSoM 2019

Program: Hewlett International Grant Program - University Center for International Studies

Project Duration: 12 months.

Level of Support: \$1,500

Principal Investigator: **Rizzo**

Funded Period: 05/01/19 – 06/30/20

Summary: This travel grant supported Prof. Rizzo to attend and present one paper at the International Conference on Nonlinear Solid Mechanics, 16-19 June 2019, Rome, Italy.

Project Title: Solitary Wave-based easy-employable Trans-lid Tonometer (SWeTT).

Program: University of Pittsburgh, Innovation Institute, Pitt Ventures First Gear Team Application

Project Duration: 12 months.

Level of Support: \$3,000

Principal Investigator: **Rizzo; Amir Nasrollahi, Ph.D.**, Co-PIs

Funded Period: 02/01/19 – 12/31/19

Summary: The participants to the First Gear program complete a 6 to 8 week course which prepares the team to further the proposed invention/technology for commercial viability. In addition, First Gear participants qualify for additional NSF funding in the amount of \$50,000. The technology proposed in this grant is the development of a new tonometer, based on engineering principles never explored in ophthalmology, to enable the self-measurements of the intraocular pressure.

Project Title: On the quantitative analysis of a new tonometer to manage/prevent glaucoma.

Program: University of Pittsburgh, Center for Medical Innovation (CMI) Pilot Funding Program

Project Duration: 12 months.

Level of Support: \$20,000

Principal Investigator: **Rizzo; Ian Conner and Ian Sigal**, Co-PIs

Funded Period: 01/01/19 – 12/31/19

Summary: The objective of this grant is the development of a new tonometer, based on engineering principles never explored in ophthalmology, to enable the self-measurements of the intraocular pressure. The research hypothesis is that the amplitude and time of flight (ToF) of highly nonlinear solitary waves interacting with the human eye are dependent on the eye pressure.

Project Title: Nondestructive evaluation methods to reconstruct the elastic moduli of transversely isotropic rocks

Program: CEE Internal Seed Funding

Project Duration: 12 months.

Level of Support: \$69,997

Principal Investigator: **Rizzo; Andy Bungler**, Co-PI

Funded Period: 09/01/18 – 08/31/19

Summary: In this seed-grant, we investigate two inexpensive methods to estimate the elastic properties of rocks through the testing of tiny drill cuttings obtained from the formation. The first method is based on the propagation of ultrasonic waves in an oil bath where the samples are immersed. The second method is based on the propagation of highly nonlinear solitary waves (HNSWs) along 1-D chains of spherical particles in dry contact with the samples. The project will benefit from the experience of Dr. Rizzo in wave propagation for nondestructive evaluation applications, and Dr. Bungler in rock mechanics research and shale formation.

Project Title: Travel Grant: Attending the IWSHM 2017

Program: Hewlett International Grant Program - University Center for International Studies

Project Duration: 12 months.

Level of Support: \$1,500

Principal Investigator: **Rizzo**

Funded Period: 05/01/17 – 06/30/18

Summary: This travel grant supported Prof. Rizzo to attend, present one paper and chair one session at the 2017 International Workshop on Structural Health Monitoring (IWSHM 2017) to be held at Stanford University, California, in September 2017.

Project Title: Novel Hand-Held Tonometer to Measure IOP Anywhere Anytime

Program: CRDF, University of Pittsburgh

Project Duration: 24 months.

Level of Support: \$12,000

Principal Investigator: **Rizzo**

Funded Period: 07/01/16 – 06/30/18

Summary: In this CRDF initiation grant, an engineer and an eye-care doctor merge their expertise to develop a new tonometer able to measure intraocular pressure (IOP) anywhere anytime. The device is based on the propagation of highly nonlinear solitary waves (HNSWs). The principle of the proposed solution is simple. The HNSW-based tonometer is made of a chain of a few millimeters diameter particles, encased in a short cylinder. The tonometer is placed in contact with the upper eyelid at the central cornea. The pitch of a striker, located at the opposite end of the chain and consisting of a mass identical to the chain-composing particles, generates a single solitary pulse that propagates through the chain and is reflected at the interface with the eyelid. Our hypothesis is that the amplitude and speed of the reflected pulse are dependent on the internal pressure of the eye.

Project Title: Travel Grant: Attending the CIMTEC 2016

Program: Hewlett International Grant Program - University Center for International Studies

Project Duration: 12 months.

Level of Support: \$1,500

Principal Investigator: **Rizzo**

Funded Period: 05/01/16 – 06/30/17

Summary: This travel grant supported Prof. Rizzo to attend, present one invited lecture, and chair one session at the 5th International Conference on Smart and Multifunctional Materials, Structures and Systems (CIMTEC 2016) held in Perugia, Italy in June 5-9 2016. The conference's web page is <http://2016.cimtec-congress.org/index.php>

Project Title: Travel Grant: Attending the ETNNDT6

Program: Hewlett International Grant Program - University Center for International Studies

Project Duration: 12 months.

Level of Support: \$1,500

Principal Investigator: **Rizzo**

Funded Period: 05/01/15 – 06/30/16

Summary: This travel grant supported Prof. Rizzo to attend and present three papers at the 6th International Conference on Emerging Technologies in Non-destructive Testing (ETNNDT6) held at Vrije Universiteit Brussel, Belgium, in May 27-29, 2015.

Project Title: Can a Sound Bullet Be a Formidable Energy Harvester?

Program: Mascaro Center for Sustainable Innovation, seed program

Project Duration: 12 months.

Level of Support: \$37,850

Principal Investigator: **Rizzo**

Funded Period: 07/01/11 – 06/30/12

Summary: The overall objective of this proposal is to develop a new system to harvest energy from mechanical vibrations. The proposed system includes an infrastructure, an acoustic lens, and the circuit to store electricity. A structure subjected to vibrations is coupled to an acoustic lens, made of a set of ordered arrays of granular particles in contact with a homogeneous material. The particles are arranged to convert the structure's vibrations into solitary waves of different amplitude and speed. These waves are then focused to a single point (sound bullet) where a piezoelectric transducer bonded to the solid converts the sound bullet into an electric voltage. Finally, a passive electronic interface connected to the transducer will serve to store the electric energy. The unique and novel design of the energy harvesting system is represented by the acoustic lens that acts as a powerless amplifier that converts distributed and weak vibrations into high amplitude pulses.

Project Title: Inspection of Well-Pipes Used in Unconventional Gas Sites

Program: Swanson School of Energy Center for Energy, seed program

Project Duration: 12 months.

Level of Support: \$40,000

Principal Investigator: **Rizzo**

Funded Period: 07/01/11 – 06/30/12

Summary: We propose to develop a nondestructive inspection (NDI) system able to rapidly assess the well-pipes used to procure unconventional gas from the reservoir to the surface. The main challenge tackled in this project is the inspection of thousand feet long pipes having only one access point, located at the surface. With this seed grant we will investigate the feasibility of a novel solution that aims at addressing this challenge.

Project Title: A novel noninvasive methodology for the assessment of dental implants stability

Program: Clinical and Translational Science Institute, Engineering to Clinical Collaborative Research Pilot Program

Project Duration: 12 months.

Level of Support: \$25,000

Principal Investigator: **Rizzo**, Dr. M. Ochs, UPMC School of Dental Medicine as co-Pi

Funded Period: 07/01/11 – 06/30/12

Summary: This project aims at investigating the electro-mechanical impedance (EMI) method as a viable solution to assess dental implant stability. EMI has been used in the last decade for the structural health monitoring (SHM) of civil and aerospace structures. It consists of using one or more piezoceramic transducers (PZTs) attached to or embedded in the material (host structure) being probed. The transducer induces low- to high-frequency structural excitations when subjected to an electric field. The transducer's electrical admittance is then related to the mechanical impedance of the host structure (in this case the implant), and therefore it indirectly assesses the health of the host element.

Project Title: Travel Grant: Attending the 5th European Workshop on Structural Health Monitoring

Program: Hewlett International Grant Program - University Center for International Studies

Project Duration: 12 months.

Level of Support: \$1,000

Principal Investigator: **Rizzo**

Funded Period: 07/01/10 – 06/30/11

Summary: This proposal aims at requesting funding to attend the 5th European Workshop on Structural Health Monitoring to be held in Sorrento, Naples, ITALY. The conference will be held on 29 June - 2 July 2010. The conference's web page is <http://www.ewsh2010.eu/>. The PI is organizing a special session on Guided Waves propagation and he will present one paper.

Project Title: A Novel Approach for Acoustic Source Location
Program: University of Pittsburgh CRDF - Small Grant Program
Project Duration: 24 months.
Level of Support: \$14,700
Principal Investigator: **Rizzo**
Funded Period: 07/01/09 – 06/30/11

Summary: The research objective of this proposal is to investigate the hypothesis that a small array of ground unidirectional microphones is able to passively identify the direction AND the position of air-borne or ground-borne acoustic sources. The proposed method represents a transformational approach to identify the position of sound sources.

Project Title: Enhancing Crosscutting Sustainability Education in Civil Engineering
Program: Innovation in Education Awards
Project Duration: 12 months.
Level of Support: \$24,569
Principal Investigator: **A. Landis (PI), M. Bilec and P. Rizzo as co-PIs**
Funded Period: 05/01/09 – 04/30/10

Summary: Within the context of sustainability education, we propose to connect three Civil and Environmental Engineering courses: Design for the Environment, Introduction to Nondestructive Evaluation and Structural Health Monitoring, and Green Buildings: Design and Construction. Our primary goal is to infuse sustainability concepts into civil engineering courses using active, team-based learning. We will develop three new activities that will link the three courses. As concerns of global climate change and energy independence increases, concepts of sustainability are critical components to civil engineers' education. Civil engineers will play a significant role in designing, constructing, and maintaining new energy infrastructure systems. In addition to sustainability issues, this proposal incorporates recommendations from the National Research Council for enhancing education in science, technology, engineering, and mathematics (STEM) disciplines by developing new experiences that facilitate active learning through cross-class, team-based assignments.

Project Title: Travel grant: Novel approach for the NDE of civil infrastructures
Program: University of Pittsburgh's UCIS Small Grant
Project Duration: 4 months.
Level of Support: \$500
Principal Investigator: **Rizzo**
Funded Period: 03/01/08 - 06/30/08

Summary: We request funding to attend Smart Structures and Materials & Nondestructive Evaluation and Health Monitoring 2008 International Conference (<http://spie.org/smart-structures-nde.xml>). The PI will present two papers on two different researches. The first paper proposes an improved method based on Acoustic Emission to monitor in real-time the deterioration and the disbond of CFRP-reinforced concrete structures. The second abstract proposes an innovative approach to generate and detect nonlinear stress waves to monitor the healthy/faulty condition of structural materials for civil infrastructures with particular emphasis on concrete, asphalt and steel.

Project Title: Advanced Soil Moisture Characterization by Stress Wave Propagation
Program: University of Pittsburgh's CRDF - Small Grant Program
Project Duration: 24 months.
Level of Support: \$12,888
Principal Investigator: **Rizzo**
Funded Period: 07/01/07 – 06/30/08

Summary: The overall objective of the proposed research activities is the development of a nondestructive evaluation (NDE) method based on stress wave (ultrasonic wave) propagation capable to monitor soil moisture in real-time. An integrated unit consisting of low-cost stress wave probes and

a single data acquisition system will be developed. Such unit will: 1) control the generation and detection of stress waves at different soil depths, 2) process signals to extract property-sensitive features, 3) associate signal features to terrain properties in real-time.

D.4. Funded Research Project while at the University of California, San Diego

- “On-line high-speed rail defect detection” (Co-PI with F. Lanza di Scalea as PI, Department of Transportation, Federal Railroad Administration, Amendment 3, \$237,794, 04/01/05 - 04/01/06)
- “Health monitoring to detect failure of prestressing (PS) cables in segmental box-girder bridges” (Co-PI with F. Lanza di Scalea as PI, California Department of Transportation, \$292,037, 10/01/05 - 09/30/07)
- “On-line high-speed rail defect detection” (Co-PI with F. Lanza di Scalea as PI, Department of Transportation, Federal Railroad Administration, Amendment 4, \$200,000, 04/01/06 - 04/01/07)

SUMMARY OF RESEARCH PROPOSALS AWARDED (sorted by starting date)

#	Role	Title	Amount \$ ³	Sponsor	Period
1	PI	<i>Advanced Soil Moisture Characterization by Stress Wave Propagation</i>	12,888	University of Pittsburgh - Small Grant Program	07/01/07 – 06/30/08
2	PI	<i>Sensing Technology for Damage Assessment of Sign Supports and Cantilever Poles Structures</i>	346,143	Pennsylvania Dept. of Transportation	03/01/08 – 08/31/10
3	PI	<i>COLLABORATIVE RESEARCH: Novel NDE/SHM approach based on highly nonlinear dynamics</i>	220,000 (\$452,00)	National Science Foundation	09/01/08 – 08/31/12
4	PI	<i>Highly Nonlinear Solitary Waves for NDT of Civil Structures</i>	15,000	American Society for Nondestructive Testing 2009 Fellowship Award	07/01/09 – 06/30/11
5	PI	<i>Newton’s cradle: a toy or an acoustic filter?</i>	6,000	NSF REU supplement	06/01/09 – 08/31/11
6	PI	<i>COLLABORATIVE RESEARCH: Novel NDE/SHM approach based on highly nonlinear dynamics</i>	45,250	National Science Foundation - Supplement	09/01/08 – 08/31/11
7	PI	<i>A Novel Approach for Acoustic Source Location</i>	14,700	University of Pittsburgh - Small Grant Program	07/01/09 – 06/30/11
8	Co-PI	<i>New Structural Materials for Transmission Lines</i>	10,010 (total \$46,283)	CEATI	10/01/10 – 06/30/11
9	PI	<i>Hazard Mitigation of Water Mains by Means of Immersed Active/Passive Inspection Systems</i>	300,000	National Science Foundation	09/01/10 – 08/31/14
10	PI	<i>A novel noninvasive methodology for the assessment of dental implants stability</i>	25,000	Univ. of Pittsburgh - Clinical and Translational Science Institute, Engineering to Clinical Collaborative Research Pilot Program	07/01/11 – 06/30/12
11	PI	<i>Inspection of Well-Pipes Used in Unconventional Gas Sites</i>	40,000	University of Pittsburgh’s Center for Energy seed grant	07/01/11 – 06/30/12
12	PI	<i>Can a Sound Bullet Be a Formidable Energy</i>	54,275	University of Pittsburgh’s	07/01/11 –

³ The amount in parenthesis indicates the total amount granted to Rizzo and any other collaborator within the University or outside the University of Pittsburgh.

		<i>Harvester?</i>		Mascaro Center for Sustainable Innovation	06/30/13
13	Co-PI	<i>Indirect Bridge Health Monitoring Using Moving Vehicles</i>	57,080 (total \$ 505,248)	National Science Foundation	09/01/11 – 08/31/15
14	PI	<i>Highly Nonlinear Solitary Waves for Rail Buckling Prevention</i>	72,586	Federal Railroad Administration	04/01/12 – 03/31/13
15	Co-PI	<i>Corrosion Assessment of Tubular Steel Poles</i>	18,093 (total \$93,696)	CEATI	09/01/12 – 08/31/12
16	PI	<i>COLLABORATIVE RESEARCH: Highly nonlinear transducer arrays for structural health monitoring</i>	239,971 (\$484,743)	National Science Foundation	09/01/12 – 08/31/16
17	PI	<i>Continued Investigation of Highly Nonlinear Solitary Waves for Rail Buckling Prevention</i>	68,415	Federal Railroad Administration	08/01/13 – 07/31/14
18	PI	<i>Noninvasive assessment of existing concrete</i>	132,035	Pennsylvania Dept. of Transportation	02/01/15 – 01/31/16
19	PI	<i>Merging guided ultrasonic waves and electromechanical impedance: a novel NDT paradigm</i>	20,000	American Society for Nondestructive Testing 2015 Fellowship Award	07/01/15 – 12/31/16
20	PI	<i>Metamaterials for sports engineering and path forward</i>	4,800	NSF REU supplement	09/01/15 – 08/31/16
21	PI	<i>A New Handheld Tonogram Based on Solitary Waves</i>	12,000	University of Pittsburgh - Central Research Development Fund	07/01/16 – 06/30/18
22	Co-PI	<i>Automated Rail Head Internal Flaw Characterization Using Phased Array Systems</i>	65,000 (total \$300,000)	Federal Railroad Administration	05/01/2017 – 04/30/2019
23	PI	<i>Advanced Neutral Temperature Estimation using Solitary Waves (ANTEUSW)</i>	99,994 (total \$151,385)	TRB Transit Idea (National Academy of Sciences)	05/01/2017 – 10/26/2018
24	PI	<i>EAGER: Acoustic Diode as Architectural Material (ADAM).</i>	200,000	National Science Foundation	08/01/17 – 07/31/19
25	PI	<i>Nondestructive evaluation methods to reconstruct the elastic moduli of transversely isotropic rocks</i>	69,997	CEE Internal Funding	09/01/18 – 08/31/19
26	PI	<i>A Solitary Waves Based Transducer For Engineering And Biomedical Applications</i>	360,000	National Science Foundation	08/01/18 – 07/31/21
27	PI	<i>On the quantitative analysis of a new tonometer to manage/prevent glaucoma</i>	20,000	CMI Early Stage grant	01/01/2019 – 12/31/2019
28	PI	<i>Solitary Wave-based easy-employable Trans-lid Tonometer (SWeeTT)</i>	3,000	University of Pittsburgh Ventures First Gear Team Application	02/01/2019 – 12/31/2019
29	PI	<i>Nonlinear solitary waves for the detection of corrosion at any temperature</i>	20,000	American Society for Nondestructive Testing 2019 Fellowship Award	07/01/19 – 12/31/20
30	PI	<i>Image Processing and Machine Learning Algorithms to Measure Axial Stress in Rails</i>	\$116,089 (total \$154,589)	Federal Railroad Administration	07/29/19 – 01/28/22
31	PI	<i>In-motion Track Stability Assessment using a High-resolution Camera</i>	\$16,000	Transportation Technology Center, Inc.	11/10/19 – 12/28/19
32	PI	<i>Data Management, Mining, and Inference for Bridge Monitoring</i>	361,834	Pennsylvania Department of Transportation	01/01/2020-12/31/2023
33	PI	<i>An integrated NDT system to characterize rocks</i>	20,000	American Society for Nondestructive Testing 2015 Fellowship Award	07/01/20 – 12/31/21
34	PI	<i>In-motion Track Stability Assessment using a High-</i>	\$87,500	American Association of	06/01/20 –

		<i>resolution Camera</i>		Railroads	12/31/20
35	PI	<i>Image Processing and Machine Learning Algorithms to Measure Axial Stress in Rails (Phase II)</i>	\$107,297 (total \$177,297)	Federal Railroad Administration	07/29/20 – 07/28/22
36	PI	<i>SCH: INT: Managing Glaucoma in the Digital Age: A New Tonometer to Connect Patients to their Caregivers</i>	\$1,099,984	National Science Foundation	09/01/2020 – 08/31/2024
37	PI	<i>In-motion Track Stability Assessment using (Supplemental funds to Project 34)</i>	\$22,000	American Association of Railroads	11/01/20 – 12/31/20
			\$4,382,941 (total \$5,814,647)		

SUMMARY OF TEACHING GRANTS (sorted by starting date)

#	Role	Title	Amount \$ ⁴	Sponsor	Period
1	PI	<i>Development of Undergraduate Course CEE1370 "Nondestructive Evaluation"</i>	8,000	American Society for Nondestructive Testing – Faculty Grant Award	08/01/07 – 07/30/08
2	Co-PI	<i>Enhancing Crosscutting Sustainability Education in Civil Engineering¹</i>	24,569	University of Pittsburgh Innovation in Education Awards	05/01/09 – 04/30/10
3	Co-PI	<i>CCLI Type 1: Integrating Sustainability into the Civil Engineering Curriculum Through Three Courses</i>	199,982	National Science Foundation	7/01/10 – 06/30/13
			232,551 (total \$232,551)		

SUMMARY OF TRAVEL GRANTS AWARDED (sorted by starting date)

#	Role	Title	Amount \$ ⁵	Sponsor	Period
1	PI	<i>Travel Grant</i>	500	Univ. of Pittsburgh UCIS Small Grant	03/01/08 - 06/30/08
2	PI	<i>Travel Grant</i>	1,000	Univ. of Pittsburgh – Hewlett International Faculty Committee	07/01/10 – 06/30/11
3	PI	<i>Hewlett International Grant: Travel Grant</i>	1,500	Univ. of Pittsburgh – Hewlett International Faculty Committee	05/01/15 – 06/30/16
4	PI	<i>Hewlett International Grant: Travel Grant</i>	1,500	Univ. of Pittsburgh – Hewlett International Faculty Committee	05/01/16 – 06/30/17

⁴ The amount in parenthesis indicates the total amount granted to Rizzo and any other collaborator within the University or outside the University of Pittsburgh.

⁵ The amount in parenthesis indicates the total amount granted to Rizzo and any other collaborator within the University or outside the University of Pittsburgh.

5	PI	<i>Hewlett International Grant: Travel Grant</i>	1,500	Univ. of Pittsburgh – Hewlett International Faculty Committee	05/01/17 – 06/30/18
6	PI	<i>Hewlett International Grant: Travel Grant</i>	1,500	Univ. of Pittsburgh – Hewlett International Faculty Committee	05/01/17 – 06/30/18
7	PI	<i>National Science Foundation – Travel Grant</i>	10,000	National Science Foundation	05/01/20 – 12/31/21
			17,500 (total \$17,500)		

E) Contribution to Teaching

E.1) Summary of the Courses Taught at the University of Pittsburgh. For convenience the list of courses is sorted by year to emphasize teaching load and overall contribution to teaching.

Sorted by year (Cumulative data, starting with the most recent)

Year	Term	Course	Evaluation	Enrollment	Response %	
2020	Fall	CEE 1370				
2020	Fall	CEE 2370				
2020	Fall	CEE 1105		9		
2020	Spring	ENGR 0141	3.53	55	65.5	
2019	Fall	CEE 1370	4.25	4	100	
2019	Fall	CEE 2370		4		
2019	Fall	ENGR 0141	3.95	16	75	
2019	Spring	ENGR 0141	3.28	59	91.5	
2018	Fall	CEE 1370	4.29	7	100	
2018	Fall	CEE 2370	4.20	16	93.75	
2018	Fall	ENGR 0141	3.73	27	96.30	
2018	Spring	ENGR 0141	3.79	67	79.1	
2017	Fall	CEE 1370	4.67	6	83.3	
2017	Fall	CEE 2370	3.00	7	71.4	
2017	Fall	ENGR 0141	4.17	21	85.7	
2017	Spring	ENGR 0141	4.22	65	90.8	
2016	Fall	CEE 1370/2370	4.17 / 4.13	15		
2016	Fall	ENGR 0141	3.66	35		
2016	Spring	ENGR 0141	3.74	73		
2015	Fall	CEE 1370/2370	4.4	23		
2015	Fall	ENGR 0141	3.83	29		
2015	Spring	ENGR 0141	3.44	56		
2014	Fall	CEE 1370/2370	4.07	14		
2014	Fall	ENGR 0141	3.27	28		
2014	Spring	Sabbatical leave				
2013	Fall					
2013	Spring	ENGR 0141	3.57	55		
2012	Fall	CEE 1370/2370	3.96	27		
2012	Fall	ENGR 0131	3.64	69		
2012	Spring	CEE 3330	4.33	10		
2011	Fall	ENGR 0141	3.36	18		
2011	Fall	CEE 1370/2370	4.14	22		
2010	Fall	ENGR 0141	3.75	18	66.7	
2010	Fall	CEE 1370/2370	3.89	22	86.4	
2010	Spring	ENGR 0141	3.41	37	73	

2009	Fall	ENGR 0141	2.60	22	45.5
2009	Fall	CEE 1370/2370	3.56	20	94.7
2009	Spring	ENGR 0131	3.17	17	70.6
2009	Spring	CEE 1370/2370	3.30	20	100
2008	Fall	CEE 2360	3.63	9	88.9
2008	Spring	CEE 1370/2370	3.47	15	100
2007	Fall	CEE 3330	4.14	8	87.5
2007	Spring	CEE 1370/2370	3.83	13	92.3

E.1.i) Graduate Level Independent Studies

Spring 2011: *Dynamics of Structures (CEE2360)*
Student: Mr. Tyler Stevens

Spring 2011: *A Novel Approach for Energy Harvesting (CEE2996)*
Student: Mr. Nikilesh Subramoniapillai Ajeetha (School of Information Sciences - Telecommunications)

Spring 2011: *Sound Source Localization by Means of Unidirectional Microphones (CEE3996)*
Student: Mr. Duwarahan Rajendra

Fall 2011: "Glocal" Structural Health Monitoring of Waveguides (*CEE2996*)
Student: Mr. Xuan Zhu

Fall 2010: NDT of Water Mains by means of Stress Waves (*CEE 3996*)
Student: Miss Elisabetta Pistone

Spring 2010: *Structural Health Monitoring of Immersed Structures by Means of Guided Ultrasonic Waves (CEE 3996)*
Student: Mr. Xianglei Ni

Spring 2010: Nondestructive Evaluation methods of welds: a review (*CEE 2996*)
Student: Mr. Derek Mitch

Spring 2010: Nondestructive Evaluation methods of welds: a review (*CEE 3996*)
Student: Mr. Michael Richards

E.2) Main Classroom Innovations Introduced

- i) **DEVELOPMENT OF A NEW COURSE: CEE1370/2370.** This is a course that introduces students to the broad fields of nondestructive evaluation (NDE) and structural health monitoring (SHM).

In Fall 2006 my efforts focused on the development of the curriculum, preparation of new notes, and preparation of about 300 hundreds power point slides. In Spring 2007 the course was offered for the first time to an audience of graduate students only. Since Spring 2008, fueled by the 2007 ASNT (American Society for Nondestructive Testing) Faculty Grant, the course became cross listed and open also to undergraduate students as an elective course. Since then the slides were refined and new material was added based upon feedback provided by students or by the availability of new equipment and materials.

I teach this course once a week in the late afternoon to allow the participation of professional graduate students. I cover several methods of NDE and SHM such as ultrasonic testing, infrared thermography, modal analysis, microwave testing, eddy current, and some element of digital signal processing. I discuss the fundamental principles but also the findings from recent researches. The aim is to bridge the gap between the coursework and the most up to date developments. This is accomplished by creating modules that derive from my research or by distributing copies of peer-reviewed articles.

During the term I alternate regular lectures with practical demonstrations using the state-of-the art equipment available at my laboratory (Laboratory for the NDE and SHM studies). In these laboratory sessions, I show “live” methods such as ultrasonic testing, infrared thermography, and acoustic emission (AE). Students are requested to use some of the equipment shown during these sessions to complete the class assignment. For instance one lecture consists of the use of AE to monitor a steel rebar subjected to tensile load-unload cycles and load to failure. As the experiment progresses the concepts of the AE method as well as of the software and hardware used during the experiment are explained.

I invite engineers from private companies to expose students to the everyday challenges associated with the applications of NDE / SHM in the field. Speakers with expertise in the area of infrared testing, bridge inspection, and nuclear power plant inspection lectured in the past. Moreover, undergraduate students are requested to attend the graduate seminars whenever the seminar talk is in the area of SHM or NDE.

Besides the ASNT Faculty Award (2007), the course material has been improved using resources available through the University of Pittsburgh Innovation in Education Awards and the NSF CCLI project Integrating Sustainability into the Civil Engineering Curriculum Through Three Courses (see sections D.1 and D.3).

Undergraduate students have three projects. In the first assignment, they check-out an infrared camera and they survey their home/apartment to identify cold/hot spots. The chief objectives of this assignment are: 1) to become proficient at using an IR camera to perform a small scale “energy audit”; 2) to estimate the heat loss through a section of an exterior wall; 3) to estimate the energy savings with the design improvement. In the second project they check out equipment to conduct the ultrasonic inspection of welded joints of a real truss structure. Finally, the third assignment consists of analyzing the data and writing a short research paper about the experiment that delves with the Acoustic Emission method.

The undergraduate students have to report the findings of one of the assignments to the entire class by preparing a 10-15 minutes power point presentation and answering questions from the audience and from me.

Graduate students have to work on a review paper on topics assigned by me. The paper must have at least 15-20 references and must be presented to the class via a power point lecture. The goal is prepare the students for a career in academics as well as to teach them the material for the course.

All graduate and undergraduate students are requested to report their findings/works during a 20-minutes power point based presentation.

ii) **INTEGRATING SUSTAINABILITY ACROSS CURRICULUM.** I infused elements of sustainability into CEE1370/2370. For instance with the contribution of my colleagues Drs. Bilec and Landis we cross-pollinated elements of sustainability into CEE1370/2370 and vice versa. For instance I teach the NDE method of Infrared Thermography in courses such as CEE 1217: Green Building Design & Construction and CEE 1218: Design for the Environment. These lectures serve teach the fundamental principles of how infrared technology used then to perform energy audits of buildings and homes.

iii) **INNOVATION INTO EXISTING COURSES.**

a. **ENGR 0131: Statics for Civil and Environmental Engineering.** The course provides the students with the theory and application of one of the engineering mechanics disciplines: Statics. The course is the first step for the transition from basic science and mathematics courses to Civil Engineering courses. Students learn to solve engineering problems associated with simple structures such as beams, trusses, cables, etc. The course introduces to the equilibrium of a particle and of a rigid body using vector analysis and the concepts of force system resultants. Then, elements of structural analysis are introduced. The theory and the application of the geometry of the section are presented towards the end of the term.

My main contribution to the development of ENGR 0131 at Pitt was the transition from conventional chalk and board lecture style to a power-point based lecture style. To allow this transition, I spent time in the preparation of new notes and the preparation of about 200 power point slides. The advantage of this transition is two-fold: (1) allows to present high quality figures and equations; (2) allows to save time that is used to discuss and solve more example problems than done before the transition.

b. **ENGR 0141: Mechanical of Materials for Civil and Environmental Engineering.** The course expands upon the knowledge learnt in Statics to understand the relationship between load and stresses, and between load and strain. Students become familiar with the concepts of stress and strain, and learn to evaluate the effect of axial load, torsion, bending, shear force, and internal pressure on the deformation of simple structures and on the development of internal stresses.

Like for ENGR 0131, I gradually moved from a conventional chalk and board lecture style to electronic-based lecture style by creating about 250 power point slides. A few years after Pitt introduced Courseweb, I transitioned my course/lecture materials to this online resource. The benefit for my course development was that students would find there the necessary resources, information, and communication from the instructor anytime and anywhere.

c. **CEE 1105: Materials for Civil Engineering.** For this course I have created hundreds of PPT slides that I delivered remotely. The slides contain YouTube videos to reinforce the theories and principles and show how construction materials are used in job sites.

d. **CEE 3330: Structural Stability.** Initially, this course reviews the concepts of buckling from the perspective of an undergraduate Mechanics of Materials course. Then, CEE 3330 delves with the analysis of the elastic stability of structural systems. The following main topics are covered: 1) fundamental concepts of stability analysis; 2) exact buckling

solutions for long-slender (Euler/Bernoulli) and shear-deformable (Timoshenko) beam columns; 3) energy based linear and nonlinear finite element solutions to study the buckling of complex frame structures; 4) stability of in-plane loaded shear deformable plates.

For this class I wrote my own handouts (about 200 pages) which I used as a main “textbook”. The students appreciated the handouts and had no problems whatsoever to pass the course with high grades.

E.3) Contributions to Non-Classroom Teaching

- I advised few undergraduate students to achieve their goals in terms of applications to graduate school.
- I helped (by writing a recommendation letter and providing feedback on the statement of research) two undergraduate students to apply for the NSF Graduate Fellowship
- I helped (by writing a recommendation letter and providing feedback on the statement of research) one undergraduate student to apply for the Los Alamos Laboratories Summer School.
- I served as supervisor for the following co-op undergraduate students:
 - ✓ AY 16-17: Scott Overacker
 - ✓ AY 14-15: Alexandria Marie Carolan. Tyler J. Zak;
 - ✓ AY 12-13: Alaina M. Elias
 - ✓ AY 07-08: Jen Dietrich, Michael Hartranft;

E.4) Teaching Workshops Attended

Spring 2009. Attended a teaching workshop organized by the Swanson School of Engineering.

E.5) Non-Teaching Workshops Attended

- AY 17-18: Attended the 2-days CFE Professional Development Workshop: “Networking for People Who Hate Networking” led by Devora Zack and organized by the SSOE Center for Faculty Excellence.
- AY 08-09: Academic Entrepreneurship: The Business of Innovation Commercialization (Organized by the Office of Technology Management)
- AY 08-09: How To Seek Funding From Corporations and Foundations (Organized by Pitt’s Office of Human Resources).
- AY 09-10: “Grammar, Punctuation, and Proofreading: Ensuring Professional Presentation”, (organized by the office of human resources)
- AY 09-10: “Writing With Style—Official University Style, That Is”, (organized by the office of human resources)

F) Graduate Students and Mentoring Activities (in this list I included all personnel I have advised)

F.1) Visiting Professors (Academic position held in the Country of origin)

Assist. Prof. Jiangang Han (August 2009 – July 2010)	(Support: Chinese Fellowship)
Assist. Prof. Mahmoud Bayat (January –August 2019)	(Support: Own)

F.2) Postdoctoral Students

- Dr. Xianglei Ni (January 2012-December 2012) (Support: Pitt-MCSI)
- Dr. Venu G.M. Annamdas (April 2008- February 2009) (Support: PennDOT)
- Dr. Amir Nasrollahi (January 2019-September 2019) (Support: CEE seed, funding, NSF)

F.3) Ph. D. Students (in parenthesis the term of graduation)

- Mr. Alireza Enshaein (Sept. 19 – present) (Support: TA)
- Mr. Yuhui Zheng (Spring 19 - present) (Support: Seed funding, self, NSF, ASNT Fellowship)
- Mr. Xiao Zhu⁶ (Sept. 18 – Apr. 19) (Support: TA, NSF)
- Miss Hoda Jalali (Jan. 18 – present) (Support: TA, NSF)
- Mr. Amir Nasrollahi (Jan.15 – Dec.18) (Support: PennDOT, Pitt CRDF, TRB IDEA Program)
- Mr. Kaiyuan Li (Spring 16) (Support: CfE seed funding, NSF)
- Mr. Abdollah Bagheri (June 15) (Support: FRA, NSF)
- Miss Elisabetta Pistone (Fall 13) (Support: NSF)
- Mr. Jeffrey Dellowade⁷ (Support: NSF_DCL)
- Mr. Xianglei Ni (Fall 11) (Support: NSF, ASNT Fellowship)

F.4) M.S. Students: Thesis Option (in parenthesis the term of graduation)

- Mr. Matthew Belding (January 2020 – present) (Support: NSF, FRA)
- Miss Zhaoyun Ma (Fall 16) (Support: TA, Departmental Funds, 04 Accounts)
- Mr. Cai Luyao (Summer 13) (Support: U.S. FRA)
- Mr. Ayidin Tabrizi (Fall 12) (Support: Pitt's CTSI)
- Mr. Xuan Zhu (Fall 10) (Support: Startup, Pitt's CRDF, PENNDOT, NSF)
- Mr. Mahdi Tajari (Spring 10) (Support: Startup, Pitt's CRDF)
- Miss Jennifer Kacin (Spring 09) (Support: SSOE Fellowship, PennDOT)
- Mr. Sandeep Degala (Spring 08) (Support: Startup)

F.5) Visiting Scholars⁸ (in parenthesis the period they worked at Pitt. Sorted by starting date)

⁶ Moved to the University of Utah as Ph.D. student.

⁷ Mr. Dellovade is a student with disabilities. He stepped down to work in his family-owned business.

- Mr. Bowen Zheng (Sept. 18 – present) (Support: self)
- Mr. Sefa Orek (Jan. 17 – present) (Support: Fellowship from Turkey)
- Miss Wen Deng (Sept. 14 – Aug. 16) (Support: Fellowship from China)
- Mr. Adriano Di Cara (Feb. 14 – April 14) (Support: Fellowship from Italy)
- Miss Emma La Malfa Ribolla (Jan. 14 – July 14) (Support: U.S. FRA)
- Mr. Vincenzo Gulizzi (Feb. 14 – Aug. 14) (Support: U.S. NSF)
- Miss Emma La Malfa Ribolla (Mar. 13 – Sept. 13) (Support: Fellowship from Italy)
- Mr. Vincenzo Gulizzi (Feb. 13 – Aug. 13) (Support: Fellowship from Italy)
- Mr. Giuseppe Rubino (Apr. 12 – Oct. 12) (Support: self-support)
- Miss Ambra Vandone (Nov. 10 – May 11) (Support: self-support)
- Mr. Giovanni Boemio (Jan. 10 – June 10) (Support: self-support)
- Mr. Antonino Spada (Nov. 08 – Oct. 09) (Support: Fellowship from Italy)
- Mr. Michele Sale (Sept. 07 – Mar. 08) (Support: Startup)
- Mr. Vincenzo Licata (Sept. 07 – Mar. 08) (Support: Startup)
- Mr. Giacomo Bordoni (Sept. 07 – Mar. 08) (Support: Startup)
- Mr. Marcello Cammarata (Feb. 07 – Apr. 09) (Support: Startup, Fellowship from Italy)

F.6) University of Pittsburgh’s Undergraduate Research Assistants Funded on Research Projects (Time Employed)

- Mr. Matthew Belding (Sum 19, Fall 19) (Support: NSF)
- Mr. Christopher Borland (Sum 15, Spr. 16) (Support: Pitt, NSF REU)
- Mr. Bruk Berhanu (Sum 11) (Support: Pitt’s Fellowship)
- Mr. Paul Werentges (Sum 10-Fall 10) (Support: Pitt’s Fellowship, NSF REU)
- Miss Dhvani Patel (Fall 09 – Spr 10) (Support: NSF REU, Pitt’s CRDF)
- Miss Victoria Kennedy (Sum 10) (Support: ASNT)
- Miss Ricki Garden (Sum 09) (Support: NSF REU)

Key Accomplishments of the people advised at UPitt (Last update August 2018)

<u>Name</u>	<u>Role</u>	<u>Number of peer reviewed papers</u>	<u>Placement (if known)</u>
<i>Prof. Jiangang Han</i>	Visiting Professor	1	Back to his Academic Institution
<i>Dr. Venu G.M. Annamdas</i>	Postdoc	1	National University Singapore
<i>Dr. Xianglei Ni</i>	Ph.D. and Postdoc	10	INTECSEA, WorleyParsons Group
<i>Amir Nasrollahi</i>	Ph.D. (ongoing)	10	N/A
<i>Abdollah Bagheri</i>	Ph.D.	13	Postdoc, University of Virginia
<i>Kaiyuan Li</i>	Ph.D.	12	Mathworks Inc., Google
<i>Elisabetta Pistone</i>	Ph.D.	4	Vienna Consulting Engineers, Austria
<i>Miss Zhaoyun Ma</i>	M.S.	1	Ph.D. at University of South Carolina

⁸ Gulizzi, Rubino, Vandone, Boemio, Sale, and Bordoni performed research in the framework of their M.S. Thesis in Italy. La Malfa Ribolla, Licata, and Cammarata spent a post-M.S. period of research in my group. Spada spend one year of his Italian Ph.D. in the U.S. working under my supervision.

			(Mechanical Engineering)
<i>Mr. Cai Luyao</i>	M.S.	3	Ph.D. at Purdue University (Bioengineering)
<i>Mr. Ayidin Tabrizi</i>	M.S.	1	Not known
<i>Mr. Xuan Zhu</i>	M.S.	4	Ph.D. at UC San Diego (Structural Engineering)
<i>Mr. Mahdi Tajari</i>	M.S.	1	Not known
<i>Miss Jennifer Kacin</i>	M.S.	1	Not known
<i>Mr. Sandeep Degala</i>	M.S.	2	Not known
<i>Miss Wen Deng</i>	Visiting Scholar while Ph.D. student at own country	4+1	Northwestern Polytechnical University
<i>Miss Emma La Malfa Ribolla</i>	Visiting Scholar	5	Ph.D. student at the University of Palermo, Italy
<i>Mr. Vincenzo Gulizzi</i>	Visiting Scholar	4	Ph.D. student at the University of Palermo, Italy
<i>Miss Ambra Vandone</i>	Visiting Scholar	2	Ph.D. student at the University of Palermo, Italy
<i>Mr. Giovanni Boemio</i>	Visiting Scholar	1	Not known
<i>Mr. Antonino Spada</i>	Visiting Scholar while Ph.D. student at own country	4	Assistant Professor at the University of Palermo, Italy
<i>Mr. Michele Sale</i>	Visiting Scholar	1	ENI, Italy
<i>Mr. Giacomo Bordoni</i>	Visiting Scholar	1	Italcementi, Italy
<i>Mr. Marcello Cammarata</i>	Visiting Scholar	4	Ph.D. at the University of Palermo, Italy
<i>Mr. Bruk Berhanu</i>	Research Undergraduate	1 + 1 conference	M.S. at the University of Texas at Austin
<i>Miss Ricky Garden</i>	Research Undergraduate	2 conference papers	Not known

G) Honors and Awards

- **2020 Fellowship Research Award** of the ASNT (granted as a Faculty Advisor). Mr. Yuhui Zeng is the graduate student receiving the Fellowship.
- **2020 A.J. Durelli Award.** This award is intended to recognize younger members of the Society for Experimental Mechanics (SEM) for contributions made early in their career. As stated in the award letter, the award was given “*for your outstanding NDE and structural health monitoring innovations and contributions to the field of experimental mechanics*”.
- **2019 Best Paper award competition.** Ranked 3rd by the editorial board of the *ASME Journal of Nondestructive Evaluation, Diagnostics and Prognostics of Engineering Systems* for the paper: Amir Nasrollahi, Piervincenzo Rizzo (2019). “Numerical Analysis and Experimental Validation of a Nondestructive Evaluation Method to Measure Stress in Rails” *ASME J Nondestructive Evaluation*, August 2019, Vol. 2, Issue 3. The top 3 papers are recognized at the 47th Annual Review of Progress in Quantitative Nondestructive Evaluation (QNDE), Radisson Blu Downtown Minneapolis, Minneapolis, MN,; July 26 – 30, 2020.
- **2019 Fellowship Research Award** of the ASNT (granted as a Faculty Advisor). Miss Hoda Jalali is the graduate student receiving the Fellowship.
- **2019 Distinguished Structural Engineering Alumni Lecture Award.** This is a new award that the faculty at the University of California at San Diego created in 2018 to recognize an outstanding alumnus of the Department who has made outstanding contributions to one or more of the disciplines within the Department of Structural Engineering. I was the first recipient. Awardee delivers a 30-minute lecture during our 2019 SE Research Showcase (<https://seshowcase.ucsd.edu/>).
- **2018 Invited to attend** the “*Next-Generation Non-Destructive Evaluation*” Workshop on November 13, 2018 in Washington, DC. The workshop is sponsored by MForesight: Alliance for Manufacturing Foresight, a federally funded national consortium focused on enhancing U.S. manufacturing competitiveness through partnering with the broader manufacturing community to inform policies and investment in advanced manufacturing technology development. The attendance is by invitation only.
- **2018 Invited to attend and present** at the “*National Science Foundation Connections in Smart Health Workshop*” on 24-26 September 2018 in Arlington, VA. The workshop is sponsored by NSF and the attendance is by invitation only.
- **2018 Invited to attend and present** the talk “*A Combined Monitoring Approach for Medical Implants*” at the *Monitoring Osseointegrated Program Review* sponsored by the Office of Naval Research and Hosted at the University at Buffalo, 16-17 May 2018. This attendance to this event was by invitation only.
- **2017 ASNT Outstanding Paper Award** received for the paper: Evola, P., Rizzo, P., and *Vandone, A. (2016). “Fractal Analysis Applied to Laser-spot Thermography,” *Materials Evaluation*, 74(3), 409-417.
- **2016 CHANCELLOR’S DISTINGUISHED RESEARCH AWARD, Junior Scholar Award.** The award includes faculty members who, by virtue of the exceptional quality of their early contributions, have demonstrated great potential as scholars and have achieved some international standing. Candidates for this award must have received their highest degree no more than 12 years before the time of nomination.
- **2015 SHM POY.** A structural health monitoring person of the year (SHM-POY) is selected by the editors and associate editors of *Structural Health Monitoring: An International Journal*. The

POY made an outstanding contribution to the field of SHM that will benefit society. This contribution can be in the form of theory, analysis, applications, education, or other ways that support the discipline of SHM and benefit society. The award is meant to recognize accomplishments within the past year or few years.

- **2015 Fellowship Research Award** of the ASNT (granted as a Faculty Advisor). Mr. Amir Nasrollahi is the graduate student receiving the Fellowship.
- **2013.** Project “Messengers of Knowledge” awarded by the Italian Department of Education, University and Scientific Research (Ministero dell’ Istruzione dell’ Universita’ e della Ricerca: MIUR) for the project titled *Mechanics of Materials for Civil, Environmental, Mechanical and Aerospace Engineers*. The peer-reviewed award is to teach one course at the University of Palermo, Italy in Fall 2013.
- **2013 ASNT Outstanding Paper Award** received for the paper: Ni, X., and **Rizzo, P.** (2012). “Use of highly nonlinear solitary waves in NDT,” *Materials Evaluation*, **70**(5), 561-569.
- **2012: Achenbach Medal.** The Achenbach Medal has been created to recognize a young individual who has made an outstanding contribution to the advancement of the field of Structural Health Monitoring. Every year only one individual is selected for this honor.
- Who’s Who in America (2011 Edition)
- **2009 Fellowship Research Award** of the ASNT (granted as a Faculty Advisor). Mr Xianglei Li is the graduate student receiving the Fellowship.
- 2009 Innovation in Educational Excellence Award from the University of Pittsburgh
- Lister Vickery Trophy, 1st prize winner of the “INSEAD Comitel 16th Business Venture Competition, INSEAD Business Plan Competition 2008” (Solitonik Team), June 2008.
- 25th Silver Anniversary Edition of Who’s Who in the World (September 2007)
- **2007 Faculty Grant Award** from the American Society for Nondestructive Testing
- 9th edition of Who’s Who in Science and Engineering (September 2006)
- **2002 Fellowship Research Award** of the ASNT (granted as a graduate student)
- Italian Professional Engineering license: 1998-2015

H) Professional Service Activities

H.1) Department, School, University and Other Institutions

H.1.i) Other Institutions

2020-present. NCHRP Topic Panel on State of Practice on Infrastructure Inspections for the Digital Age SN5201, Panel Member.

2019. University of Palermo, Italy (School of Engineering). Instructor of a 5-day short course titled “Controllo nondistruttivo e monitoraggio strutturale per velivoli e componenti aeronautici” – Nondestructive evaluation and structural health monitoring for aerospace structures and components.

2012 – 2017.

Member of the Pennsylvania State Transportation Innovation Council (STIC) Maintenance Technical Advisory Group (TAG). States STIC were created nationwide to foster ownership and pride in establishing a process in which ideas, innovative techniques and processes can be evaluated and implemented quickly and proficiently. The TAG has been created to review, evaluate and provide suggestions on potential benefits and uses of initiatives or techniques. The TAGs will be responsible for ensuring that the chosen initiatives succeed in improving the transportation system and will be required to develop a deployment plan and track the initiatives progress.

2007. I worked on the preparation of an ASCE workshop in collaboration with Drs. Casson and Harries (from Pitt’s CEE) and Dr. J. Garrett (Thomas Lord Professor and Head, Civil and Environmental Engineering at Carnegie Mellon University, Pittsburgh). The workshop was cancelled due to low enrollment.

Ph.D. Students – Committee member:

Marco Giuliani (May 2014, University of Bologna, Italy)

Alejandro Gutiérrez (May 2014, University of Bologna, Italy)

Marco Miniaci (May 2014, University of Bologna, Italy)

Michele Palermo (May 2014, University of Bologna, Italy)

Luca Patruno (May 2014, University of Bologna, Italy)

Giulia Scalet (May 2014, University of Bologna, Italy)

Fernando Cerda (September 2012, Carnegie Mellon University, Pittsburgh)

Debaditya Dutta (Aug. 2010, Carnegie Mellon University, Pittsburgh)

Seungban Kim (Dec. 2008, Carnegie Mellon University, Pittsburgh)

H.1.ii) University

Fulbright Campus Interview Committee: Member (2017).

Member: University of Pittsburgh Conflict of Interest Committee (September 2012 June 2013). I resigned because I left for a Sabbatical leave on August 2013.

Panel reviewer: Hewlett International Grant Program, University Center for International Studies, University of Pittsburgh (2011, **2015**).

Reviewer: Central Research Development Fund (CRDF) - FY 19.

Reviewer: Pitt Momentum Fund (2019); University of Pittsburgh.

Ph.D. Students – Committee:

Yuttasart Nitipaichit (Dec. 2010, Department of Information Science and Technology, University of Pittsburgh)

H.1.iii) SWANSON School of Engineering

Mentor: Member of the Mentoring Committee for Jingtong Hu (ECE) (2019)

Member: Swanson School of Engineering Appointment, Promotion, and Tenure Review Committee (Fall 2016 – 2017).

Ph.D. Students – Committee member:

Qiuyan Li (MEMS, expected graduation 2019)

Qi Li (MEMS, expected graduation 2018)

Konstantin V. Redkin (MEMS, graduated Summer 2014)

H.1.iv) Department of Civil & Environmental Engineering

Member and Chair, AIS Faculty Search Committee: (*Fall 2019-Spring 2020*)

Member and Chair, AIS Faculty Search Committee: (*Fall 2016*)

Member and Chair, AIS Faculty Search Committee: (*Fall 2015*)

Member, Non-tenure track Faculty Search Committee: (*Fall 2014/Spring 2015*)

Member and Chair, Environmental Engineering and Sustainable Engineering Faculty Search Committee: (*Fall 2014/Spring 2015*)

Member, Structures Faculty Search Committee: (*Fall 2010/Spring 2011*)

Member, Structures Faculty Search Committee: (*Fall 2008/Spring 2009*)

Member, Structures Faculty Search Committee: (*Fall 2007/Spring 2008*)

Floor Coordinating Group: (*Summer 2009 - 2012*)

Ph.D. Students – Committee (University of Pittsburgh):

Ramzi Yosaf (Expected December 2018)

Sami Al-Ghamdi (Summer 2015)

Bahram Notghi (August 2014)

Ronald Gutierrez (April 2013)
Tyler W. Davis (November 2012)
Bhavna Sharma (April 2010)
Brandon Chavel (March 2008)

MS Students – Committee (University of Pittsburgh):

Timothy Eckert (Oct. 2009)
Jarrett Kasan (Jan. 2009)
Karthik Ramanathan (Feb. 2008)
Andrew Peck (Dec. 2007)
Jeremy .K. Ketter (Nov. 2007)
Elizabeth J. Abraham (Nov. 2006)
Keith L. Coogler (Nov. 2006)
Patrick L. Minnaugh (Oct 2006).

H.2) Positions of leadership (committee chair, local section chair, etc.) in professional and other technical or scientific society committees

2006-Present	American Society for Nondestructive Testing (ASNT): Member
2008-Present	International Society for Optics and Photonics (SPIE): Member
2008-2010	Acoustical Society of America (ASA): Member
2014 – present	Engineering Mechanics Institute (ASCE EMI): Member
2014 - present	American Society of Civil Engineers (ASCE): Member
2014 – 2018	Member of the ASME NDE Technical Committee on Ultrasonics for Mechanical Systems
2017 – present	Engineers Without Borders (EWB): Member
2017 – present	The Early Career Researchers Committee of ISHMII (ECR-ISHMII): International Society of Structural Health Monitoring of Intelligent Infrastructure. Vice-chair.
Lifetime member	Society for Experimental Mechanics (SEM)

H.3) Conference(s) organized and/or chaired, including title(s), name(s) of sponsoring organization(s), and date(s).

Workshop CHAIR (and Main Organizer):

EWSHM 2020, 10th European Workshop on Structural Health Monitoring, Palermo, Italy, 6-9 July 2020 (Due to COVID-19 the Workshop was moved to June 2021).

International Advisory Board or Member of the Scientific Committee :

Scientific Committee member: 5th International conference on Structural Engineering and Concrete Technology (ICSECT'20), originally planned from April 19-21, 2020 in Lisbon, Portugal. Moved online 18-20 October 2020.

Symposium P "Embodying Intelligence in Structures and Integrated Systems" of CIMTEC 2016 5th International Conference "Smart and Multifunctional Materials, Devices, Structures", Perugia, Italy, June 5-10, 2016.

6th Edition of the International Conference on Emerging Technologies in NDT(ETNDT6), Brussels, Belgium, May 2015

4th Int. Conf. Smart Materials Structures Systems, Montecatini Terme, Italy, June 2012.

Organizing / Program Committee member:

SPIE 2020 Conference, 27–30 April 2020, Proceedings of SPIE Vol. 11379, Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems. Smart Structures and Material & NDE and Health Monitoring Intl. Conference, Anaheim (CA), USA.

SPIE 2020 Conference, 27–30 April 2020, Proceedings of SPIE Vol. 11381, Health Monitoring of Structural and Biological Systems IX. Smart Structures and Material & NDE and Health Monitoring Intl. Conference, Anaheim (CA), USA.

The 12th International Workshop on Structural Health Monitoring (IWSHM 2019), September 10-12, 2019, Stanford, California, USA. This year, as part of the organizers' duties, I was also in the committee to select the best paper award competition.

SPIE 2019 Conference, 3–7 March 2019, Proceedings of SPIE, Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems. Smart Structures and Material & NDE and Health Monitoring Intl. Conference, Denver (CO), USA.

SPIE 2019 Conference, 3–7 March 2019, Proceedings of SPIE, Health Monitoring of Structural and Biological Systems XIII. Smart Structures and Material & NDE and Health Monitoring Intl. Conference, Denver (CO), USA.

SPIE 2018 Conference, 4–8 March 2018, Proceedings of SPIE, Health Monitoring of Structural and Biological Systems XI. Smart Structures and Material & NDE and Health Monitoring Intl. Conference, Denver (CO), USA.

SPIE 2018 Conference, 4–8 March 2018, Proceedings of SPIE, Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems. Smart Structures and Material & NDE and Health Monitoring Intl. Conference, Denver (CO), USA.

The 11th International Workshop on Structural Health Monitoring (IWSHM 2017), September 12-14, 2017, Stanford, California, USA.

SPIE 2017 Conference 10170, 25–29 March 2017, Proceedings of SPIE Vol. 10170, Health Monitoring of Structural and Biological Systems XI. Smart Structures and Material& NDE and Health Monitoring Intl. Conference, Portland (OR), USA.

SPIE 2016 Conference 9805, 21–24 March 2016, Proceedings of SPIE Vol. 9805, Health Monitoring of Structural and Biological Systems VIII. Smart Structures and Material& NDE and Health Monitoring Intl. Conference, Las Vegas, USA.

SPIE 2015 Conference 9438, 9–12 March 2014, Proceedings of SPIE Vol. 9438, Health Monitoring of Structural and Biological Systems VIII. Smart Structures and Material& NDE and Health Monitoring Intl. Conference, San Diego, USA.

SPIE 2014 Conference 9064, 10–13 March 2014, Proceedings of SPIE Vol. 9064, Health Monitoring of Structural and Biological Systems VIII. Smart Structures and Material& NDE and Health Monitoring Intl. Conference, San Diego, USA.

SPIE 2013 Smart Structures and Material& NDE and Health Monitoring Intl. Conference, San Diego, USA, March 2013.

SPIE 2012 Smart Structures and Material& NDE and Health Monitoring Intl. Conference, San Diego, USA, March 2012.

Special Session Organizer:

Mini-Symposium: MS91: Machine Learning and Data Analytics for Infrastructure Integrity Assessment: Engineering Mechanics Institute Conference, Massachusetts Institute of Technology, Boston, MA, May 29 – June 1st. <https://umi.mit.edu/mini-symposia> (Organized with Dr. Hao Sun, Univ. of Pittsburgh and Dr. Oral Buyukozturk, Massachusetts Institute of Technology)

Special Session: ASME IMECE 2016, Track 17-3 NDE, Diagnosis, and Prognosis: Guided Ultrasonic Waves in Structures for NDE and SHM. ASME's International Mechanical Engineering Congress and Exposition (IMECE), Phoenix, AZ, November 11 – 17, 2016 (<http://www.asmeconferences.org/IMECE2016/TechnicalTracks.cfm>)

Special Session: Acoustic Emission: 5th European Conference on Structural Control, Genoa, Italy, 18-21 June 2012. (<http://www.eacs2012.org/>)

Special Session G-6: Advances and Challenges in the SHM of Civil and Aerospace Structures: 4th Int. Conf. Smart Materials Structures Systems, Montecatini Terme, Italy, June 2012.

Special Session Topic: Guided wave propagation
5th European Workshop on SHM, June 29 – July 2 2010, Sorrento, Italy.

Panel moderator:

SHM Emerging Applications Roadmap, September 3rd 2015 at the 10th International Workshop on Structural Health Monitoring, Stanford, CA, Sept. 1-3, 2015

Panelist:

Carnegie Mellon's Center for Sensed Critical Infrastructure Research Hosts Pre-G-20 Panel on Smart Technologies for Buildings, Transportation Systems, Carnegie Mellon University, Pittsburgh, September 9th, 2009:
http://www.cmu.edu/news/archive/2009/September/sept4_infrastructurepanel.shtml

Best Paper Award judge member:

The 12th International Workshop on Structural Health Monitoring (IWSHM 2017), September 10-12, 2019, Stanford, California, USA (For papers submitted to sessions *Civil Structures*).

Chair:

The 12th International Workshop on Structural Health Monitoring (IWSHM 2019), September 10-12, 2019, Stanford, California, USA (Session: Civil Structures IV)

SPIE Smart Structures and Material& NDE and Health Monitoring, Denver, CO, 6 March 2019 (Conference 10972: Session 9: Civil Infrastructure Monitoring I).

21st IEEE International Conference on Intelligent Transportation Systems (ITSC 2018), Maui, Hawaii, USA, November 4-7, 2018, Special Session on Railway Transportation (I), TuAT8.

27th ASNT Research Symposium, Orlando, FL, USA, 26-29 March 2018. Session on Structural Health Monitoring

SPIE Smart Structures and Material& NDE and Health Monitoring, Denver, CO, 6 March 2018 (Conference 10600: Session 6: Medical/Biomedical Applications).

The 11th International Workshop on Structural Health Monitoring (IWSHM 2017), September 12-14, 2017, Stanford, California, USA (Session: Diagnostics I)

SPIE Smart Structures and Material& NDE and Health Monitoring, Portland, OR, March 2017 (Conference 10170: Session 2).

CIMTEC 2016, 5th International Conference "Smart and Multifunctional Materials, Devices, Structures", Perugia, Italy 5-9 June 2016.

10th International Workshop on Structural Health Monitoring, Stanford, CA, Sept. 1-3, 2015 (Session Sensors/Actuators I)

SPIE Smart Structures and Material& NDE and Health Monitoring, San Diego, CA, March 2015 (Conference 9438: Session 13a).

SPIE Smart Structures and Material& NDE and Health Monitoring, San Diego, CA, March 2014 (Conference 9064: Session 1b. Conference 9061: Sessions 2a).

SPIE Smart Structures and Material& NDE and Health Monitoring, San Diego, CA, March 2013 (Conference 8695: Session 9. Conference 8692: Sessions 17).

SPIE Smart Structures and Material& NDE and Health Monitoring, San Diego, CA, March 2012 (Conference 8345: Session 2a. Conference 8348: Sessions 4b, 11, 13).

SPIE Smart Structures and Material& NDE and Health Monitoring, San Diego, CA, March 2007 (Session 28 – Conference 6529)

Co-chair:

The 11th International Workshop on Structural Health Monitoring (IWSHM 2017), September 12-14, 2017, Stanford, California, USA (Session: Recent Advances in Ultrasonics V).

NDE for Health Monitoring and Diagnostics Conferences of SPIE's 11th Int'l Symposium, San Diego, CA, February 2006

NDE for Health Monitoring and Diagnostics Conferences of SPIE's 10th Int'l Symposium, San Diego, CA, March 2005.

Judge:

Intel International Science and Engineering Fair (ISEF), Pittsburgh, PA, May 10-15 2015

H.4) Journal editorships or journal editorial board service.

Editorial Board:

The Scientific World Journal (Mechanical Engineering): 2013 - present
Sensors (ISSN 1424-8220; CODEN: SENS99): Associate Editor 2014 – present
Frontiers in Built Environment - Editorial Board of Structural Sensing: Review Editor 2015-present
Structural Health Monitoring, an International Journal: Associate Editor 2016 – present
The Open Civil Engineering Journal: Associate Editor 2017 – present
Applied Sciences (ISSN 2076-3417; CODEN: ASPCC7), an international peer-reviewed open access journal by MDPI, Section Board for '*Acoustics and Vibrations*': 2019 - present

Review Editor:

Frontiers in Mechanics of Materials: 2018 - present

Special Issue Guest Editor:

Advances in Civil Engineering (2010)
Advances in Civil Engineering (2011)

Reviewer for the following peer-reviewed journals (in parenthesis the number of papers reviewed). More than one hundred twenty (125) different journals:

Acta Materialia (1);
Advanced Composite Materials (1);
Advances in Civil Engineering (1);
Advances in Structural Engineering (3);
AIAA Journal (2);
Algorithms (1);
Applied Acoustics (2);
Applied Computational Intelligence and Soft Computing (1);
Applied Sciences (2);
ASCE Journal of Bridge Engineering (5);
ASCE Journal of Composites for Construction (2);
ASCE Journal of Engineering Mechanics (1);
ASCE Journal of Infrastructure Systems (1);
ASCE Journal of Materials for Civil Engineering (5);
ASCE Journal of Structural Engineering (1);
ASME Journal of Computational and Nonlinear Dynamics;
ASME Journal of Dynamic Systems, Measurement and Control;
ASME Journal of Nondestructive Evaluation, Diagnostics and Prognostics of Engineering Systems (2);
ASME Journal of Pressure Vessel Technology (1);
ASME Journal of Vibration and Acoustics (1);
Automation in Construction (1);
Biomaterials (1);
Biomechanics and Modeling in Mechanobiology (1);
Biomedical Engineering Letters (2);
Bridge Engineering, Proceedings of the Institution of Civil Engineers (1);
Climate Change (1);
Construction and Building Materials (8);
Composite Interfaces (1);
Composite Structures (3);

Computer-Aided Civil and Infrastructure Engineering (1);
Computers and Concrete, An International Journal (1);
Dental Implants and Dentures: Open Access. OMICS PUBLISHING - BIOBIO GROUP (1);
Electronics (ISSN 2079-9292; CODEN: ELECGJ), by MDPI (1)
Energies (ISSN 1996-1073)(1);
Engineering Structures (1);
Experimental Mechanics (6);
Experimental Techniques (3);
Experimental Thermal and Fluid Science (1);
Geotechnical Testing Journal (1);
Hindawi Journal of Electrical and Computer Engineering (1);
Hindawi Journal of Engineering (1);
Hindawi Journal of Sensors (1);
IEEE Access (1);
IEEE Transactions on Mechatronics (1);
IEEE TUFFC (7);
IET Circuits, Devices & Systems (1);
IET Electronics Letters (1);
Indian Journal of Engineering & Materials Sciences (1);
Infrared Physics & Technology (1);
Insight (3);
International Journal of Pressure Vessels and Piping (1);
International Journal for Numerical Methods in Biomedical Engineering (1);
International Journal for Numerical Methods in Engineering (1);
International Journal of Distributed Sensor Networks (1).
International Journal of Engineering and Technology Innovation (1);
International Journal of Fracture (1);
International Journal of Pavement Engineering (3);
International Journal of Smart and Nano Materials (1);
International Journal of Solids and Structures (1);
ISA Transactions (2)
Journal of Applied Physics (1)
Journal of Applied Sports Sciences (1);
Journal of the Acoustical Society of America (4)
Journal of Biomechanics(1);
Journal of Computational and Nonlinear Dynamics (1);
Journal of Dentistry: Oral Health & Cosmesis (1);
Journal of Dentistry and Oral Care Medicine (1);
Journal of Earth Science Research (1);
Journal of Engineering and Technological Sciences (1);
Journal of Engineering and Technology Research (1);
Journal of Geophysics and Engineering (1);
Journal of Intelligent Material Systems and Structures (15);
Journal of Manufacturing Systems (1);
Journal of Marine Science and Engineering (1);
Journal of Materials Engineering and Performance (1);
Journal of Mechanical Engineering and Sciences (1);
Journal of Mechanical Engineering Science, Part C (1)
Journal of Nondestructive Evaluation (7);
Journal of Oral Health and Dental Science (JOHDS) (1);
Journal of Sound and Vibration (12);

Journal of Structural Control and Health Monitoring (14);
Journal of Structural Integrity and Maintenance (1);
Journal of Testing and Evaluation (2);
Journal of the Mechanical Behavior of Biomedical Materials (3);
Journal of the Royal Society Interface (1);
Journal of Vibration and Control (1);
Materials (ISSN 1996-1944) (1);
Materials Evaluation (2);
Materials Research Express (an IOP journal) (1);
Mathematical Problems in Engineering (1);
Measurement, Journal of the International Measurement Confederation (2);
Measurement Science and Technology (5);
Mechanical Systems and Signal Processing (2);
Metals (ISSN 2075-4701) (1);
Multiscale and Multidisciplinary Modeling, Experiments and Design (1);
NDT&E International (8);
Open Journal of Acoustics (1);
Optics and Laser Technology (1);
Optics and Lasers in Engineering (1);
Philosophical Transactions A of the Royal Society (2);
Physica A: Statistical Mechanics and its Applications (1);
Plos ONE (1);
Proceedings of the IEEE (1);
Proceedings of the IMechE, Part O: Journal of Risk and Reliability (2);
Quantitative InfraRed Thermography Journal (1);
Recent Patents on Material Science (1);
Research in Nondestructive Evaluation (5);
SAGE Open Engineering (1);
Scientific Reports (1);
Scientific Research and Essays (1);
Sensors (4);
Sensors and Actuators A: Physical (2);
Shock and Vibration, an open access journal published by Hindawi (1);
Smart Materials and Structures (34);
Smart Structures and Systems (4);
SoftwareX (1);
Steel and Composite Structures, an International Journal (1);
Strain, an International Journal for Experimental Mechanics (1);
Structural Health Monitoring, an International Journal (14);
Structural Engineering and Mechanics (1);
Structural Monitoring and Maintenance, An International Journal (1);
Structure and Infrastructure Engineering (1);
Transportation Geotechnics (1);
Ultrasonics (14)
The Scientific World Journal (1);
Wood Science and Technology (1).

Reviewer for the following monograph (in parenthesis the number of papers reviewed):

ASNT: *NDT Handbook on Ultrasonics* (1);

Reviewer for the following peer-reviewed conferences (in parenthesis the number of papers reviewed).

ASME Pressure Vessels & Piping Conference (1);

EWSHM 2020 (Proceedings only; conference postponed to 2022 due to COVID 19);

Reviewer for the following twenty-two (24) funding agencies/programs sorted in alphabetical order (in parenthesis the year the review was performed).

In bold those activities after June 2011.

- American University of Sharjah (**2018**)
- Belgium Research Foundation - Flanders (Fonds Wetenschappelijk Onderzoek - Vlaanderen, FWO): **2017**.
- Belgium: The Université libre de Bruxelles (ULB) (**2019**)
- Cariplo Foundation, Italy (**2011, 2019, 2020**);
- China National Science Foundation (NSFC) /RGC (Hong Kong) Joint Research Scheme (**2010**);
- Department of Energy, Consolidated Innovative Nuclear Research (**2016, 2017, 2018**);
- Department of Energy, SBIR Program (**2016**);
- US Department of Energy Office of Science, Small Business Innovation Research (SBIR) Phase 1 Release 2 (**2017, 2018**);
- European Commission: H2020-WIDESPREAD-2018-2020 program (2019)
- Fonds de recherche du Québec – Nature et technologies (Québec, CANADA, **2014**)
- Greek Ministry of Education, Life Long Learning and Religious Affairs: program COOPERATION 2011 (SYNERGASIA 2011), (**2012**).
- Greek Ministry of Education, Life Long Learning and Religious Affairs: Thalys Program (**2011**).
- Greek Ministry of Education, Life Long Learning and Religious Affairs: Archimedes III Program (**2011**).
- Israeli Ministry of Science, Technology and Space, Research Program "*Applied and Engineering Researches*" (**2016, 2018**);
- NASA (**2015, 2016**);
- NCHRP (National Cooperative Highway Research Program) Topic Panelist (**2020**);
- Polish National Science Centre, funding scheme PRELUDIUM (**2017**)
- Research Grants Council, Hong Kong (2008-present; each year at least 4-6 proposals reviewed);
- Qatar National Research Fund (2007);
- United Arab Emirates University (**2014**);
- United States National Science Foundation: *ad hoc reviewer* (2010, **2014, 2019**);
- United States National Science Foundation, program: IRES (served twice as *ad hoc reviewer*);
- United States National Science Foundation, program: MRI (served once, **2013**);
- United States National Science Foundation, CMMI Division (2010, 2011, **2012(served twice), 2013(served twice), 2014, 2016, 2018**);
- University of South Carolina's Institutions of Higher Education: NASA - Research and Education Awards Program (REAP) (**2013**).

Reviewer of Ph.D. thesis for the following Foreign Institution:

- Indian Institute of Technology, Delhi;

H.5) Conferences Attended (since September 2006)

- 62 ASNT Fall Conference, Las Vegas, 19-21 November 2019
- 61 BMES 2019, Philadelphia, October 2019
- 60 9th ECCOMAS Thematic Conference on Smart Structures and Materials, 6-8 July 2019, Paris (France)
- 59 ICoNSoM 2019, International Conference on Nonlinear Solid Mechanics, 16-19 June 2019, Rome (Italy).
- 58 SPIE Smart Structures/NDE 2019, Denver, CO, USA, 3-7 March 2019
- 57 IMECE 2018, ASME International Mechanical Engineering Congress & Exposition, Pittsburgh, PA, USA, November 9-15, 2018.
- 56 21st IEEE International Conference on Intelligent Transportation Systems (ITSC 2018), Maui, Hawaii, USA, November 4-7, 2018.
- 55 Connections in Smart Health Workshop, Arlington, VA (USA), 24-26 September 2018 (Workshop organized by the NSF, by Invitation only)
- 54 9th European Workshop on Structural Health Monitoring, Manchester, UK, 10-13 July 2018.
- 53 Symposium on Dynamic Response and Failure of Composite Materials, DRAF 2018, Ischia (Naples), Italy, June 2018.
- 52 98th Joint Rail Conference (JRC 2018), Pittsburgh, PA, USA, 18-20 April 2018.
- 51 27th ASNT Research Symposium, Orlando, FL, USA, 26-29 March 2018.
- 50 SPIE Smart Structures/NDE 2018, Denver, CO, USA, 4-8 March 2018
- 49 Transportation Research Board, 97th annual meeting, January 7-11, 2018 Washington, D.C.
- 48 The 11th International Workshop on Structural Health Monitoring (IWSHM 2017), September 12-14, 2017, Stanford, California, USA
- 47 XXIII Congresso - Associazione Italiana di Meccanica Teorica e Applicata (XXIII Congress of the Italian Association of Theoretical and Applied Mechanics), Salerno, 4-7 Settembre 2017, Italy
- 46 12th International Conference on Structural Safety and Reliability, Technische Universit'at Wien, Vienna, Austria, 6–10 August 2017.
- 45 SPIE Smart Structures/NDE 2017, Portland, OR, USA, 25-29 March 2017
- 44 172nd Meeting of the Acoustical Society of America, Honolulu, Hawaii, 28 Nov. – 2 Dec. 2016
- 43 3rd Mediterranean International Workshop on Photoacoustic & Photothermal phenomena: focus on biomedical and nanoscale imaging and NDE, Erice (Italy), 19 – 26 October 2016.
- 42 CIMTEC 2016, 5th International Conference "Smart and Multifunctional Materials, Devices, Structures", Perugia, Italy 5-9 June 2016.
- 41 2016 EMI (Engineering Mechanics Institute) Conference, Nashville, TN, May 22-25, 2016
- 40 2015 ASNT Fall Conference, Salt Lake City, Utah, Oct. 26-29, 2015.
- 39 10th International Workshop on Structural Health Monitoring, Stanford, CA, Sept. 1-3, 2015
- 38 XXIII IGF national meeting, 1st International Edition, Favignana (TP), Italy, June 22-24, 2015
- 37 6th Edition of the International Conference on Emerging Technologies in NDT(ETNDT6), Brussels, Belgium, May 2015.
- 36 SPIE Smart Structures/NDE 2015, San Diego, CA, 8-12 March 2015.
- 35 IMAC XXXIII A Conference and Exposition on Structural Dynamics, Orlando, FL, February 2-5, 2015
- 34 94th TRB Conference, Washington D.C., USA, January 11-15, 2015.
- 33 ASCE Shale Gas Conference, Pittsburgh, PA, USA, July 21-23, 2014.
- 32 7th European Workshop on Structural Health Monitoring, Nantes, France, July 8-11, 2014.
- 31 SPIE's 21th Annual International Symposium on Smart Structures and Materials – San Diego, CA, March 2014.

- 30 SMART2013, 6th ECCOMAS Thematic Conference on Smart, Structures and Materials, Turin, Italy 24-26 June 2013
- 29 SPIE's 20th Annual International Symposium on Smart Structures and Materials – San Diego, CA, March 2013.
- 28 93rd TRB Conference, Washington, D.C., USA, 13 – 17 January 2013.
- 27 164th Meeting of the Acoustical Society of America, Kansas City, MO, USA 22-26 October 2012
- 26 ASNT NDE/NDT for Highways and Bridges: Structural Materials Technology (SMT 2012), New York, NY, USA, 21-24 August 2012
- 25 5th European Conference on Structural Control (EACS 2012), Genoa, Italy, June 2012.
- 24 4th CIMTEC Intl. Conf. on Smart Materials and Structures Systems, Montecatini Terme, Italy, June 2012.
- 23 SPIE's 19th Annual International Symposium on Smart Structures and Materials – San Diego, CA, March 2012.
- 22 Conferenza Nazionale sulle Prove non Distruttive Monitoraggio Diagnostica (Italian Conference on Nondestructive Testing and Diagnostics), Florence, Italy October 26-28, 2011
- 21 8th Intl. Workshop on Structural Health Monitoring, Stanford, CA, September 13-15, 2011.

- 20 2011 SEM Annual Conference & Exposition on Experimental and Applied Mechanics, Mohegan Sun, Uncasville, Connecticut USA June 13 - 16, 2011.
- 19 Intl. Symp. on Nondestructive Testing of Materials and Structures, NDTMS-2011, 15-18 May 2011, Istanbul, Turkey.
- 18 SPIE Defense Security + Sensing Conference, Unattended Ground, Sea, and Air Sensor Technologies and Applications XIII, Orlando, Florida, April 2011.
- 17 ASNT 20th Annual Research Symposium & Spring Conference, San Francisco, CA, Mar. 21-25, 2011.
- 16 SPIE's 18th Annual International Symposium on Smart Structures and Materials – San Diego, CA, March 2011.
- 15 2011 NSF Engineering Research and Innovation Conference, Atlanta, Georgia, January 2011.
- 14 159th Meeting of the Acoustical Society of America, Cancun, Mexico, November 2010.
- 13 5th European Workshop on Structural Health Monitoring, June 29th – July 2nd 2010, Sorrento, Italy.
- 12 SPIE's 17th Annual International Symposium on Smart Structures and Materials, San Diego, CA, March 2010.
- 11 2009 ANST Fall Conference & Quality Testing Show, 19-23 Oct. 2009, Columbus, OH.
- 10 2009 IEEE International Ultrasonics Symposium, Rome, Italy, September 2009.
- 9 7th International Workshop on Structural Health Monitoring, Stanford, CA, September 9-11, 2009.
- 8 2009 NSF Engineering Research and Innovation Conference, Honolulu, Hawaii, June 2009.
- 7 Western Pennsylvania Transp. Res. Forum, June 17, 2009, Pittsburgh, PA
- 6 SPIE's Defense, Security, and Sensing 2009, 13 - 17 April 2009, Orlando, Florida, USA.
- 5 156th Meeting of the Acoustical Society of America, Miami, FL, November 2008
- 4 3rd CIMTEC Intl. Conf. on Smart Materials and Structures Systems, Acireale, Italy, June 2008.
- 3 Western Pennsylvania Transp. Res. Forum, June 4, 2008, Pittsburgh, PA.
- 2 SPIE's 15th Annual International Symposium on Smart Structures and Materials – San Diego, CA, March 2008.
- 1 6th International Workshop on Structural Health Monitoring, Stanford, CA, September 11-13, 2007.
Annual Transportation Research Board Conference, January 2007, Washington, DC.

I) Contribution to Diversity (sorted from the oldest to the latest)

- Summer 2007 – Supervised the summer research activity of Mr. Jeremy Tarrt, an African-American graduate student.
- Fall 2007 - Assigned a special investigation to Jeremy Tarrt. He conducted a literature review and wrote a review paper on acoustic emission for ground and underground pipelines.
- March 2008 – May 2009. Supported and supervised Miss Jennifer Kacin, female M.S. graduate student. She completed her Master on April 2009. Her work was partially supported by PennDOT.
- Fall 2008 – Spring 2009. Miss Victoria Kennedy, African-American undergraduate, conducted research in my laboratory supporting the work of one Ph.D. student. Miss Kennedy was supported through a faculty award grant from the American Society for Nondestructive Testing.
- Spring 2009 - present. Mr. Jeffrey Dellovade, Ph.D. student with disabilities, is being supported through a NSF DCL grant.
- Summer – Fall 2009. Miss Ricki Garden, female undergraduate student conducted research in my laboratory. She was supported through an NSF supplement. She co-authored few conference papers (see list of publications).
- Fall 2009 – Spring 2010. Miss Dhwani Patel, female undergraduate student conducted research in my laboratory. She was supported through an NSF supplement and a Pitt’s CRDF small grant. She co-authored a peer-review paper just submitted. I also helped her to apply for an NSF Graduate Fellowship.
- August 2010 – December 2013. Miss Elisabetta Pistone pursued her Ph.D. in my research group supported by an NSF grant. Her graduation is expected for the end of 2013.
- May 2011 – April 2012. Mr. Bruk Berhanu, African-American student, is conducting research under my supervision, supported by a Pitt’s REU.
- 2013 – 2014. Hosted Miss Emma La Malfa Ribolla, doctoral student from the University of Palermo.
- September 2014 - present. Hosted Miss Wen Deng, doctoral student from China, sponsored with a Chinese Fellowship.
- September 2015 – December 2016. Miss Zhaoyun Ma is pursuing her M.S. in my research group. Expected graduation Fall 2016.
- September 2017 – present. Miss Hoda Jalali is pursuing her Ph.D. in my research group. Expected graduation TBD.
- In summary:

Category	Ph.D.	M.S.	REU	Visiting
Women	2	2	3	3
African-American			2	
Student with disabilities	1			

J) Consulting Activities

- 2011 - 2014 AvantiTek, LLC San Diego, California.
- 2007- 2008 Allertek, LLC Pittsburgh, Pennsylvania.

K) Other

K.1) Community Service, Outreach Activities

- Fall 2020 and Spring 2021: Dynamo Travel Soccer organization, Pittsburgh: Head Coach for a U14 Boy team, and Assistant Coach for U12 boy Team.
- Fall 2019 and Spring 2020: Dynamo Travel Soccer organization, Pittsburgh: Head Coach for a U13 Boy team, and Assistant Coach for U11 boy Team.
- Spring 2019 – Panelist for the Civil Engineering Day Outreach Event, organized by the ASCE Pittsburgh section to expose high school students from the Allegheny County to the civil engineering profession.
- Fall 2018 and Spring 2019: Dynamo Travel Soccer, Pittsburgh: Head Coach for a U12 Boy team, and Assistant Coach for U10 boy Team
- 2017-2018 Dynamo Travel Soccer, Pittsburgh: Head Coach for U11 boys
- 2016-2017 Dynamo Soccer, Pittsburgh: Head Coach for U8 children
- 2015 (Fall) Dynamo Soccer, Pittsburgh: Head Coach for U8 children
- 2015 Grand Award Judge at the Intel International Science and Engineering Fair (ISEF), Pittsburgh, PA, May 10-15.
- 2015 Booth Exhibitor for the International Society of Optics and Photonics (SPIE) at the Intel International Science and Engineering Fair (ISEF), Pittsburgh, PA, May 10-15.
- 2015 Dynamo Soccer, Pittsburgh: Assistant Coach for U-6 children
- 2014 Dynamo Soccer, Pittsburgh: Assistant Coach for U-6 children
- March 2013 – Hosted 8 high school students from the Central Valley High School. http://www.centralvalleysd.org/centralvalleyhighschool_home.aspx.
- January 2013 – Lecture on Nondestructive Evaluation and Structural Health Monitoring at the Central Valley High School. http://www.centralvalleysd.org/centralvalleyhighschool_home.aspx.
- 2012 Dynamo Soccer, Pittsburgh: Head Coach for U-6 children
- January 2011 – Gave multiple lectures at the Manchester Academic Charter School located in Pittsburgh, North Side. The school is a co-educational day school for students in Kindergarten through 8th Grade [<http://www.macsk8.org/index.html>].
- December 2009 - Gave lecture at Kentucky School [<http://www.kentuckyavenueschool.org/>] in Pittsburgh. The school serves diverse students from kindergarten through eighth grade, on infrared technology for sustainable housing.

K.2) External⁹ Collaborators:

The acronym CA indicates the co-authors of peer reviewed journal or conference papers

The acronym RP indicates PIs or co-PI in research proposals submitted together

Otherwise the nature of the collaboration is specified

- **Prof. I. Bartoli** (CA, RP), Assistant Professor, Drexel University, USA
- **Prof. L. Bellomonte** (CA), Professor, University of Palermo, Italy
- **Prof. J. Bielak** (RP), Professor, Dept. of Civil and Environmental Engineering, Carnegie Mellon University, USA.
- **Prof. F. Casciati** Professor, University of Pavia, Italy: (we organized two conferences)
- **Prof. C. Daraio** (CA, RP), Professor, California Institute of Technology, USA
- **Prof. L. De Nardo** (CA), Assistant Professor, Politecnico di Milano, Italy

⁹ Outside the University of Pittsburgh's SWANSON School of Engineering

- **Dr. C. Farrar** (CA), Director ESA Division, Los Alamos National Laboratory, USA
- **Mr. M. Fateh** (CA), program manager, Office of Research and Development, Federal Railroad Administration, USA
- **Prof. J. Garrett** (RP), Professor and Chair, Dept. of Civil and Environmental Engineering, Carnegie Mellon University, USA. (I am member of the Ph.D. committee of one of his students)
- **Prof. Gholamreza Ghodrati Amiri**, Professor, School of Civil Engineering, Iran University of Science & Technology, Tehran, Iran
- **Prof. G. Giambanco** (CA), Professor, Dept. of Structural and Geotechnical Engineering, University of Palermo, Italy.
- **Mr. Ali Zare Hosseinzadeh**, Graduate Student, School of Civil Engineering, Iran University of Science & Technology, Tehran, Iran
- **Prof. J. Kabara** (CA, RP), Assistant Professor, Dept. of Information Science and Telecommunications, University of Pittsburgh, USA. (I was member of the Ph.D. committee of one of his students)
- **Prof. J. Kovacevic** (RP), Professor, Dept. of Biomedical Engineering and Electrical and Computer Engineering, Carnegie Mellon University, USA.
- **Prof. F. Lanza di Scalea** (CA, RP), Professor, Dept. of Structural Engineering, UCSD, USA
- **Prof. A. Marzani** (CA), Assistant Professor, DISTART, University of Bologna, Italy
- **Prof. F. Matta** (CA, RP), Assistant Professor, Univ. South Carolina, USA
- **Prof. A. Milazzo** (CA), Associate Professor, University of Palermo, Italy
- **Dr. M. Ochs** DMD, MD (RP), Professor and Chair Oral & Maxillofacial Surgery, UPMC, Pittsburgh.
- **Prof. I. Oppenheim**, Professor, Carnegie Mellon University, Pittsburgh, USA (member of the Ph.D. committee of one of my students)
- **Dr. G. Park** (CA), Senior Scientist, ESA Division, Los Alamos National Laboratory, USA
- **Prof. G. Pascale** (CA), Professor, DISTART, University of Bologna, Italy
- **Prof. D. Persano Adorno** (CA), Assistant Professor, University of Palermo, Italy
- **Prof. C. Pierce** (CA, RP), Associate Professor, Univ. South Carolina, USA
- **Prof. S. Salamone** (CA, RP), Assistant Professor, SUNY Buffalo, USA.
- **Dr. C. Sfeir** (RP), Associate Professor, Associate Professor, Department of Oral Biology, Director, Center for Craniofacial Regeneration, School of Dental Medicine, University of Pittsburgh, USA.
- **Prof. F. Seible** (CA), Professor, Dean of the Jacobs School of Engineering, UCSD, USA.
- **Prof. H. Soon** (CA), Associate Professor, Civil and Environmental Engineering, KAIST, South Korea. (I was also member of the Ph.D. committee of two of his students)
- **Prof. D. Tipper** (CA, RP), Professor, Dept. of Information Sci. and Telecommunications, PITT, USA.
- **Prof. M. Vanali** (CA), Assistant Professor, Politecnico di Milano, Italy
- **Prof. E. Viola** (CA), Professor, DISTART, University of Bologna, Italy
- **Prof. J.K. Yang** (CA), Assistant Professor, University of Washington, USA
- **Prof. V. Zadorozhny** (CA, RP), Professor, Dept. of Information Science and Telecommunications, University of Pittsburgh, USA

K.3) Speakers¹⁰ hosted at Pitt for the CEE Departmental Graduate Seminars (in alphabetical order, the rank refers to the position held when invited. Fifteen total; they were seven in June 2011)

- **Prof. Raimondo Betti**, Professor, Columbia University, (26 February 2016)
- **Dr. C. Farrar**, Director ESA Division, Los Alamos National Laboratory, USA
- **Prof. Branko Glisic**, Associate Professor, Princeton University, (4 November 2015)

¹⁰ These are experts in the area of nondestructive evaluation and structural health monitoring

- **Prof. T. Kundu**, Professor, University of Arizona, Tucson, USA
- **Prof. C. Lissenden**, Professor, Pennsylvania State University, USA
- **Prof. J. Lynch**, Associate Professor, University of Michigan, USA
- **Prof. P. Nagy**, Professor, University of Cincinnati, USA
- **Prof. Satish Nagarajaiah**, Professor, Rice University, (11 November 2015)
- **Prof. Fabio Matta**, Assistant Professor, University of South Carolina, USA (2 Nov. 2012)
- **Prof. John Popovics**, Professor, University of Illinois at Urbana Champaign, (8 April 2016)
- **Prof. Maurizio Porfiri**, Associate Professor, Polytechnic University of New York (9 Nov. 2012)
- **Prof. Matteo Pozzi**, Assistant Professor, Carnegie Mellon University, (30 September 2015)
- **Prof. J. Rose**, Professor, Pennsylvania State University, USA
- **Prof. M. Ruzzene**, Professor, Georgia Institute of Technology, USA
- **Prof. L. Udpa**, Professor, Michigan State University, USA (October 2016)

K.4) The Laboratory for Nondestructive Evaluation and Structural Health Monitoring Studies

The **Laboratory for NDE and SHM studies** is a new facility that I established in September 2006 upon my arrival at the University of Pittsburgh. The facility consists of about 750 square feet of dust-free space, which contains the state-of-the-art equipment of some of the most widely used NDE methods. The laboratory includes but it is not limited to:

- 1) **Acoustic Emission Instrumentation**: one Physical Acoustics Corporation 4-channel PCI/DSP system with waveform module including a notebook computer and AE-Win software; acoustic emission pico, WD, and S14 AE-transducers.
- 2) **Ultrasonic Testing Instrumentation**: one Tektronix AFG3022 arbitrary function generator (2 output channels); one Lecroy Waverunner 44Xi 4-channels oscilloscope (with PC incorporated running under Windows XP); eight commercial broadband OlympusNDT-Panametrics Ultrasonic Transducers; one OlympusNDT-Panametrics high power (max 400 Volts) signal generator; several immersion transducers.
- 3) **Modal Testing Instrumentation**: 8-channel, line-powered, ICP® sensor signal conditioner; four 1/4 in. pre-polarized condenser microphone, free-field, 4 mV/Pa, 4 to 80k Hz (± 2 dB); Modally Tuned® Impulse Hammer w/force sensor and tips, 0 to 100 lbf, 50 mV/lbf (11.2 mV/N); one 086D80 Miniature Instrumented Impulse Hammer w/force tips, 0 to 50 lbf.
- 4) **Two National Instrument-PXI 1042Q** chassis with arbitrary function generator and multifunction Data Acquisition System;
- 5) **Infrared Thermography equipment**. We have one FLIR Infrared Camera (~8k value), one Infrared Video camera and accessories SLC400 (~50k value) for infrared thermography testing, and one FLIR lower end (~2k value) infrared camera.
- 6) **Optical testing equipment**. One optical table, one Nd:YAG pulse laser, several posts, lenses, and tools to conduct high-precision optical and laser ultrasonics testing.
- 7) **Electromechanical Impedance**. LCR meter, sensors, and general supplies to perform Electromechanical Impedance measurements
- 8) **Miscellaneous**: five acoustic microphones AT815b; seven personal computers, one laptop.

K.5) Personal Information

- Italian citizen; U.S. Permanent resident
- Married, two sons;
- Hobbies: coaching soccer, playing with my sons, reading, traveling.
- Language skills: Italian (mother tongue), English (fluent), Czech and Spanish (basic comprehension).