

Oral Buyukozturk, Ph.D.

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Photo Courtesy David Sella (ILP)

✓ **BIOSKETCH**

Dr. Oral Buyukozturk is George Macomber Professor, Professor of Civil and Environmental Engineering, and Director of the Laboratory for Infrastructure Science and Sustainability at the Massachusetts Institute of Technology (MIT). He received his Ph.D. degree in Structural Engineering from Cornell University in 1970. He joined the MIT faculty in 1976 following six years of industrial experience, including two years at United Engineers and Constructors in safety analysis and design of nuclear containment structures, and four years with Marc Analysis and Research Corporation, a Brown University affiliate, in computational engineering analysis and development. Professor Buyukozturk's research interest is in infrastructure mechanics, materials, and sustainability integrating areas of multiscale concrete mechanics for durable and sustainable structures, and innovative sensing and data analytics towards the development of intelligent structures and resilient cities. His work in these areas have led to ground breaking developments and innovations in multiscale modeling of cementitious materials with additives, use of locally available waste materials (e.g., irradiated post-consumed plastic, volcanic ash) for durable and sustainable concrete materials and construction, and in novel computer vision techniques for structural sensing with motion magnification, system identification and structural health monitoring.

His earlier work at MIT includes fundamental research and development in thermomechanical analysis of coal gasification vessels, as well as his pioneering contribution in the evolution of segmental prestressed bridge design and construction technology. He has conducted seminal research in interface fracture mechanics, innovative experimentation for interface assessment in multi-material systems, and fiber reinforced plastic (FRP) composites for structural rehabilitation. His early work at Marc Analysis/Brown University involved pioneering developments in concrete constitutive relations, and finite element analysis of complex structures with nonlinearities and progressive cracking. Computational concrete material models he developed are still in use today by major commercial general-purpose finite element programs. It is worth noting that his current work on computational multiscale concrete using molecular dynamics provides a fundamental basis for his earlier developments of phenomenological models of complex concrete behavior.

Professor Buyukozturk's research represents an integrated effort towards infrastructure sustainability through a bottom-up approach contributing to establishment of a new paradigm in infrastructure engineering. He has published more than 370 technical papers in refereed journals, edited books and conference proceedings, made more than 200 invited and keynote presentations around the world, and served in different capacities in over 20 technical committees of professional societies. His work has been recognized through multiple prestigious honors and awards including the *George W. Housner Structural Control and Monitoring Medal* from the American Society of Civil Engineers (ASCE), the *Distinguished Service and Leadership Award* from the Civil and Environmental Engineering department at MIT, the *Golden Mirko Roš Medal* of the Swiss Federal Research Laboratory for Materials Science and Technology; *Fellow (non-resident) of the Royal Society of Edinburgh*, Scotland's National Academy of Science and Letters; *ASNT National Faculty Fellowship Awards* (2008 & 2011); *Fellow of American Concrete Institute (ACI)*, and various Best Paper Awards with his students.

✓ **EDUCATION**

- Ph.D. - Cornell University (1970)
- M.S. - Cornell University
- M.S.C.E. - Istanbul Technical University

✓ **PROFESSIONAL EXPERIENCE**

- 1985 – Professor, CEE, MIT, Cambridge, MA
- 1980 – 1985 Associate Professor (with tenure), CEE, MIT, Cambridge, MA
- 1976 – 1980 Associate Professor (without tenure), CEE, MIT, Cambridge, MA
- 1973 – 1974 Adjunct Associate Professor of Engineering, Brown University, Providence, RI
- 1972 – 1976 Senior Research Engineer, Marc Analysis Research Corporation, Providence, RI
- 1970 – 1972 Research Engineer/Consultant, United Engineers and Constructors, Philadelphia, PA

✓ **RESEARCH INTERESTS**

Prof. Buyukozturk's research interests lie in the area of Infrastructure Mechanics, Materials, and Sustainability:

- Concrete mechanics and multiscale computational modeling
- Interface mechanics in multi-material systems
- Fracture and durability of FRP retrofitted concrete systems
- Sustainable construction materials
- Thermomechanical behavior of high temperature refractory linings
- Energy-based seismic design of structures
- Advanced sensing and data analytics for infrastructure monitoring

✓ **SELECTED HONORS AND AWARDS**

- 2019 Recipient of the **George Macomber Professorship, MIT Endowed Chair.**
- 2018 **George W. Housner Structural Control and Monitoring Medal** from the American Society of Civil Engineers, for *“Pioneering and transformative developments in video-based structural sensing and identification, interferometry-based data analytics, high-efficiency generic wireless networks, and their integration with groundbreaking engineering mechanics research and practice for enhancing civil infrastructural resilience and sustainability.”*
- 2018 **Distinguished Service and Leadership Award** from MIT Department of Civil and Environmental Engineering, to *“Recognize outstanding departmental service and leadership contributions of a member of the CEE faculty, to acknowledge colleagues who foster a culture of diversity, inclusiveness, and innovation, to further the department mission and vision and MIT as a whole.”*
- 2011 **Golden Mirko Ros Medal** from EMPA Swiss Federal Laboratories for Materials Science and Technology, for *“Most valuable and sustained contribution to materials science and engineering in the domain of civil engineering and also for his outstanding research support to EMPA over the past 2 decades.”*
- 2009 **Fellow of Royal Society of Edinburgh**, Scotland's, National Academy of Science and Letters, for *“Transformative contributions to computational analysis, engineering and design.”*
- 2008/11 American Society of Nondestructive Testing (ASNT) Faculty Fellowship Awards
- 1990 Fellow, American Concrete Institute (ACI)

✓ **SELECTED GRANTS**

Prof. Buyukozturk has been PI for many projects throughout his career. During the last five years only, his total funding level has been nearly 15 million USD. Here are some selected recent grants and projects:

- 1) Data Interferometry for Field Monitoring: Development and Applications in Structural and Crustal Systems (2018-2020), Oral Buyukozturk (PI) and Nafi Toksoz (Co-PI), Shell Global, \$1,310,000.00
- 2) Multi-scale Characterization of Oil-well cements for Water Dynamics and Microstructure Analysis (2017-2019), Oral Buyukozturk (PI), Aramco Services Company, \$400,000.
- 3) MIT-Kuwait Signature Project: Sustainability of Kuwait's Built Environment (2013-2017), Oral Buyukozturk (PI), Kuwait Foundation for the Advancement of Sciences, \$4,970,000.00
- 4) Motion Sensing Wi-Fi Sensor Networks, Continuous 3D Modeling and Prediction of Facility Responses to Disturbances (2011-2017), Oral Buyukozturk (PI) and William Freeman (co-PI), MIT Energy Initiative, Shell International Exploration & Production, Inc., \$8,000,000.00
- 5) A Robust Methodology for the Standoff Condition Assessment of FRP-Retrofitted Concrete Systems (2009-2013), NSF, Oral Buyukozturk (PI), \$254,999.00
- 6) De-Bonding in Bi-layer Material Systems under Moisture Effects: A Multi-Scale Fracture Approach (2009-2013), NSF, Oral Buyukozturk (PI), \$353,728.22
- 7) Moisture Affected De-Bonding in FRP Retrofitted Concrete Systems – An Interface Fracture Approach (2005-2009), NSF, Oral Buyukozturk (PI), \$262,560.35
- 8) Nondestructive Evaluation of FRP-Confined Concrete Using Microwave (2003-2008), NSF, Oral Buyukozturk (PI), \$300,308.00
- 9) A Novel Approach to Nondestructive Evaluation of FRP-Confined Concrete using Microwaves (2002-2003), NSF, Oral Buyukozturk (PI), \$99,314.15
- 10) Failure Behavior of FRP Bonded Concrete Affected by Interface Fracture (2001-2005), NSF, Oral Buyukozturk (PI), \$250,366.00
- 11) Integrity of Pre-Cracked Re-Enforced Concrete Retrofitted with Composite Laminates (1996-2000), NSF, Oral Buyukozturk (PI), \$239,936.00
- 12) Behavior of High Strength Concrete Composites Influenced by Interfacial Fracture Properties (1994-1997), NSF, Oral Buyukozturk (PI), \$246,655.00

✓ **TEACHING AND MENTORING**

Prof. Buyukozturk's life-long philosophy of civil engineering education in the area of structures and materials has been to offer courses that emphasize fundamentals and behavioral knowledge, through which innovative design solutions can be developed. In recent years, Professor Buyukozturk has played a profound role in bringing the civil engineering education program in the Department of Civil and Environmental Engineering at MIT to within a transformative program, the so-called 1-ENG umbrella, for a strong and a flexible education. During his career, he has taught over ten major undergraduate and graduate courses. He has supervised over 30 PhD students, more than 70 Master students, and over 30 undergraduate students, many of whom have developed successful careers in both academic and industrial fields.

✓ **CONSULTING**

Prof. Buyukozturk has done extensive consulting services (for nearly 40 major projects) for national and international structural engineering communities during his career. Some recent selected projects:

- Florida International University Pedestrian Bridge Collapse Investigation, Consultant, 2018
- Building Collapse Investigation, McDonough, Hacking and Lavoie LLC, Boston MA, Consultant, 2015

- *Development of Sustainability Center of Building Materials, and Infrastructures*, Kuwait Institute for Scientific Research, Consultant, 2011 - 2012
- *Delamination of Nuclear Containment Structure for Crystal River Nuclear Plant Unit 3*, State of Florida Office of Public Counsel, Structural and Material Consultant, 2011 - 2012

✓ **SELECTED MEDIA COVERAGE**

Prof. Buyukozturk's research has been reported/featured in both national and international media coverages (e.g., MIT News, NSF News, Science360 News, ASCE Civil Engineering Magazine, Science Daily, Popular Mechanics, The Wall Street Journal, Engineering News Record, The Economic Times, Newsweek, Phys.org), over 100 times. Here are some selected recent media articles:

- 1) Cities of the future may be built with locally available volcanic ash, **MIT News**, 2018
- 2) Cities of the future could be built with concrete made from volcanic ash, **Newsweek**, 2018
- 3) MIT Team Discovers Roman Secret of Volcanic Concrete to Build Future Cities, **Inverse Innovation**, 2018
- 4) MIT students fortify concrete by adding recycled plastic, **MIT News**, 2017
- 5) Students fortify concrete by adding recycled plastic, **Science Daily**, 2017
- 6) MIT students fortify concrete through recycled plastic, **Architect Magazine**, 2017
- 7) Using energy-based designs to enhance earthquake hazard resistance, **MIT News**, 2017
- 8) With new model, buildings may *sense* internal damage, **MIT News**, 2016
- 9) MIT researchers make buildings smart enough to *sense* internal damage over time, **Fox News**, 2016.
- 10) Technique to monitor building *health* utilizes ambient vibrations, **ASCE Civil Engineering Magazine**, Issue of February 2017.
- 11) Intelligent building may *sense* internal damage after earthquake, **Yahoo! News**, 2016.
- 12) Buildings of future may *sense* internal damage after earthquake, **Earthquake News**, 2016
- 13) Intelligent building may *sense* internal damage after earthquake, **The Hans India**, 2016
- 14) With New Model, Buildings May *Sense* Internal Damage, **Science Newslite Technology**, 2016
- 15) The Science Looks at Smart Buildings, Really Smart Ones, **Searching For Ithaka**, 2016
- 16) Digital nervous system would let buildings detect their own weaknesses, **Popular Mechanics**, 2016
- 17) New smart buildings may sense internal damage in real time, **India Today**, 2016
- 18) With New Computational Model, Buildings May *Sense* Internal Damage, **Tech Explorist**, 2016
- 19) MIT researchers develop sensing system to spot structural weakness in buildings, **Construction Dive**, 2016
- 20) MIT Monitors Building Health, **Durability + Design**, 2016
- 21) With new model, buildings may *sense* internal damage, **Science Daily**, 2016.
- 22) New *smart* buildings may sense internal damage in real time, **Business Standard** and **The Free Press Journal**, 2016.
- 23) Intelligent building may *sense* internal damage after earthquake, **The Economic Times Science**, 2016.
- 24) New 'smart' buildings may sense internal damage in real time, **Business Standard**, 2016
- 25) Future buildings could *sense* internal damage after earthquake, says research, **India TV News**, 2016
- 26) Intelligent building may *sense* internal damage after earthquake, **News X**, 2016
- 27) Designing a better built environment, **MIT ILP Institute Insider**, 2016
- 28) Magnifying vibrations in bridges and buildings, **MIT News**, 2015
- 29) CEE Magnifies Vibrations in Bridges and Buildings, **MIT CEE News**, 2015
- 30) Magnifying vibrations in bridges and buildings, **Global News Connect**, 2015
- 31) Researchers apply computer vision technique to see tiny vibrations in large structures, **Phys.org**, 2015

- 32) A concrete solution - Insight into cement's microscopic properties may lead to stronger, more sustainable concrete, **MIT News**, 2017.
- 33) Researchers look to nature for solutions to *greener*, more sustainable concrete production, **American Ceramic Society**, 2016
- 34) Finding a new formula for concrete, **MIT News**, 2016
- 35) Finding a New Formula for Concrete, **Science News Line Physics & Chemistry**, 2016
- 36) Finding a New Formula for Concrete, **European Coatings**, 2016
- 37) Learning how things fall apart, **MIT News**, 2014
- 38) Learning how things fall apart, **NSF News**, 2014
- 39) Learning how things fall apart, **Science360 News**, 2014
- 40) CEE's Buyukozturk receives lifetime achievement award from Swiss Federal Labs, **MIT News**, 2011
- 41) Monitoring Tiny Vibrations to Avert Big Problems, **The Wall Street Journal**, 2015.

✓ **SELECTED RECENT JOURNAL PUBLICATIONS**

Prof. Buyukozturk has published extensively during his career (over 350 technical papers in refereed journals, edited books and conference proceedings). He has also delivered over 200 keynote and invited presentations and filed 11 US patents. Selected recent journal publications are given below.

NOTE: For a full list of publications please see the Full CV of Prof. Buyukozturk at <http://web.mit.edu/liss/home.html>

2016-2019 Journal papers

- 1) J. Long, O. Buyukozturk. A power optimised and re-programmable system for smart wireless vibration monitoring. *Structural Control and Health Monitoring* 2019, accepted and in press.
- 2) K. Kupwade-Patil, P. Boul, D. Rasner, M. Everett, T. Proffen, K. Page, D. Ma, D. Olds, C. Thaemlitz, O. Buyukozturk, Retarder effect on Hydrating Oil Well Cements investigated using in situ Neutron/X-ray Pair Distribution Function (PDF) Analysis, *Cement and Concrete Research*, 2019, accepted and in press.
- 3) M. Uzun, H. Sun, D. Smit and O. Buyukozturk. Structural identification and damage detection using Bayesian inference and seismic interferometry. *Structural Control and Health Monitoring* 2019; DOI:10.1002/stc.2445.
- 4) R. Zhang, Z. Chen, J. Zheng, O. Buyukozturk, and H. Sun. Deep long short-term memory networks for nonlinear structural response prediction. *Computers & Structures* 2019; 220: 55-68.
- 5) H. Sun, J. Al-Qazweeni, J. Parol, H. Kamal and O. Buyukozturk. Computational modeling of a unique tower in Kuwait for structural health monitoring: numerical investigations. *Structural Control & Health Monitoring* 2019; 26(3): e2317.
- 6) A. Gullu, Y. Ercan, C. Yalcin, A. Dindar, H. Ozkaynak, and O. Buyukozturk. An improved input energy spectrum verified by the shake table tests. *Earthquake Engineering & Structural Dynamics* 2019; 48(1), 27-45.
- 7) K. Kupwade-Patil, A. Bumajdad, C. Brown, M. Tyagi, N. Butch, A. Jamsheer and O. Buyukozturk. New Insights into Water Dynamics of Portland Cement Paste with Nano-additives using Quasielastic Neutron Scattering. *Journal of Material Science* 2019; 54(6), 4710-4718.
- 8) T. Herring, C. Gu, M. Nafi Toksoz, J. Parol, A. Al-Enezi, F. Al-Jeri, J. Al-Qazweeni, H. Kamal and O. Buyukozturk. GPS Measured Response of a Tall Building due to a Distant Mw 7.3 earthquake. *Seismological Research Letters* 2018; 90(1), 149-159.
- 9) C. Gu, G.A. Prieto, A. Al-Enezi, F. Al-Jeri, J. Al-Qazweeni, H. Kamal, S. Kuleli, A. Mordret, O. Büyüköztürk, M.N. Toksöz. Ground Motion in Kuwait from Regional and Local Earthquakes: Potential Effects on Tall Buildings. *Pure and Applied Geophysics* 2018; 175(12): 4183-4195. DOI: 10.1007/s00024-018-1943-5

- 10) J. G. Chen, Travis M. Adams, H. Sun, Erin S. Bell and O. Buyukozturk. Camera-based vibration measurement of the Portsmouth, NH WWI Memorial Bridge. *ASCE Journal of Structural Engineering* 2018; 144(11): 04018207.
- 11) S. D. Palkovic, K. Kupwade-Patil, S. Yip, O. Buyukozturk. Random field finite element models with cohesive-frictional interactions of a hardened cement paste microstructure. *Journal of the Mechanics and Physics of Solids* 2018; 119: 349-368.
- 12) A. Jamsheer, K. Kupwade-Patil, A. Bumajdad, O. Buyukozturk. Analysis of Engineered Cement Paste using Silica Nanoparticles and Metakaolin using ²⁹Si NMR, Water Adsorption and Synchrotron X-ray Diffraction. *Construction and Building Materials* 2018, 180(20): 698-709.
- 13) Kupwade-Patil, K., Chin, S., Johnston, M., Maragh, J., Masic, A., and Buyukozturk, O. Particle size Particle Size Effect of Volcanic Ash towards developing Engineered Portland Cements. *ASCE Journal of Materials in Civil Engineering* 2018, 30(8): 04018190.
- 14) Mohammadi Ghazi R, Y. Marzouk, Büyüköztürk O. Conditional classifiers and boosted conditional Gaussian mixture model for novelty detection. *Pattern Recognition* 2018, 81: 601-614.
- 15) C. Schaefer, K. Kupwade-Patil, M. Ortega, C. Soriano, O. Buyukozturk, A. White, and M. Short. Irradiated Recycled Plastic as a Concrete Additive for Improved Chemo-mechanical Properties and Lower Carbon Footprint. *Waste Management* 2018; 71, 426-439.
- 16) K. Kupwade-Patil, C. De Wolf, S. Chin, J. Ochsendorf, A.E. Hajiah, A. Al-Mumin, and O. Büyüköztürk. Impact of Embodied Energy on materials/buildings with partial replacement of ordinary Portland Cement (OPC) by natural Pozzolanic Volcanic Ash. *Journal of Cleaner Production* 2018; 177: 547-554.
- 17) K. Kupwade-Patil, S. Chin, J. Illavsky, R. Andrews, A.E. Bumajdad, AND O. Buyukozturk. Hydration kinetics and morphology of cement pastes with Pozzolanic Volcanic Ash studied via Synchrotron based Techniques, *Journal of Material Science* 2018; 53 (3), 1743-1757
- 18) K. Kupwade-Patil, S. Palkovic, A.E. Bumajdad, C. Soriano, and O. Buyukozturk. Use of Silica Fume and Natural Volcanic Ash as a replacement to Portland Cement: Micro and Pore structural Investigation using NMR, XRD, FTIR and X-ray Micro Tomography. *Construction and Building Materials* 2018; 158, 574-590
- 19) H. Sun and O. Buyukozturk. The MIT Green Building benchmark problem for structural health monitoring of tall buildings. *Structural Control and Health Monitoring* 2018, 25(3): e2115.
- 20) Y.-J. Cha, S. Mahmoudkhani and O. Büyüköztürk. Autonomous Structural Visual Inspection Using Region-Based Deep Learning for Detecting Multiple Damage Types. *Computer-Aided Civil and Infrastructure Engineering* 2018; 33(9): 731-747.
- 21) S. D. Palkovic, S. Yip, O. Buyukozturk. A cohesive-frictional force field (CFFF) for colloidal calcium-silicate-hydrates. *Journal of the Mechanics and Physics of Solids* 2017; 109: 160-177.
- 22) R. Masmoudi, K. Kupwade-Patil, A. Bumajdad, O. Buyukozturk. *In situ* Raman Studies on Cement Paste prepared with Natural Pozzolanic Volcanic Ash and Ordinary Portland Cement. *Construction and Building Materials* 2017; 148: 444-454.
- 23) S. D. Palkovic, S. Yip, O. Buyukozturk. Constitutive response of calcium-silicate-hydrate layers under combined loading. *Journal of the American Ceramic Society* 2017; 100(2): 713-723.
- 24) A Zhou, O Buyukozturk, D Lau. Debonding of concrete-epoxy interface under the coupled effect of moisture and sustained load. *Cement and Concrete Composites* 2017. 80: 287-297.
- 25) N. Wadhwa, J. G. Chen, J. B. Sellon, D. Wei, M. Rubinstein, R. Ghaffari, D. M. Freeman, O. Buyukozturk, P. Wang, S. Sun, S. H. Kang, K. Bertoldi, F. Durand, and W. T. Freeman. A Motion

- Microscope for Visualizing and Quantifying Small Motions. *Proceedings of the National Academy of Sciences of the United States of America - PNAS* 2017, 114(44): 11639-11644
- 26) Gu, C., F. Al-Jeri, A. Al-Enezi, O. Büyüköztürk, M.N. Toksöz. Source mechanism study of local earthquakes in Kuwait. *Seismological Research Letter* 2017; 88 (6), 1465-1471
 - 27) Mordret, H. Sun, G. A. Prieto, N. Toksoz and O. Buyukozturk. Continuous monitoring of high-rise buildings using seismic interferometry. *Bulletin of the Seismological Society of America* 2017; 107 (6), 2759-2773
 - 28) J. G. Chen and O. Buyukozturk. A symmetry measure for detecting changes in mode shapes. *Journal of Sound and Vibration* 2017; 408: 123-137.
 - 29) Z. Dzunic, J. G. Chen, H. Mobahi, O. Buyukozturk, J. W. Fisher. A Bayesian state-space approach for damage detection and classification. *Mechanical Systems and Signal Processing* 2017; 96: 239-259.
 - 30) R. Mohammadi Ghazi, J. G. Chen and O. Buyukozturk. Pairwise graphical models for structural health monitoring with dense sensor arrays. *Mechanical Systems and Signal Processing* 2017; 93: 578-592.
 - 31) Y.-J. Cha, W. Choi and O. Buyukozturk. Deep learning-based crack damage detection using convolutional neural networks. *Computer-Aided Civil and Infrastructure Engineering* 2017; 32(5): 361-378.
 - 32) J. Long and O. Buyukozturk. Decentralised One Class Kernel Classification Based Damage Detection and Localisation. *Structural Control and Health Monitoring* 2017; 24(6): e1930.
 - 33) Davis, K.L. Bouman, J.G. Chen, M. Rubinstein, O. Buyukozturk, F. Durand and W.T. Freeman. Visual Vibrometry: Estimating Material Properties from Small Motions in Video. *IEEE Transactions on Pattern Analysis and Machines Intelligence* 2017; 39(4): 732-745.
 - 34) Y.-J. Cha, J. G. Chen and O. Buyukozturk. Output-only computer vision based damage detection using phase-based optical flow and unscented Kalman filters. *Engineering Structures* 2017; 132, 300-313.
 - 35) H. Sun, A. Mordret, G. A. Prieto, N. Toksoz and O. Buyukozturk. Bayesian characterization of buildings using seismic interferometry on ambient vibrations. *Mechanical Systems and Signal Processing* 2017; 85: 468-486.
 - 36) G. Yan, H. Sun and O. Buyukozturk. Impact load identification for composite structures using Bayesian regularization and unscented Kalman filter. *Structural Control and Health Monitoring* 2017; 24(5): e1910
 - 37) J. G. Chen, A. Davis, N. Wadhwa, F. Durand, W. T. Freeman and O. Buyukozturk. Video camera-based vibration measurement for civil infrastructure applications. *ASCE Journal of Infrastructure Systems* 2017; 23(3): B4016013.
 - 38) S. Palkovic, D.B. Brommer, K. Kupwade-Patil, A. Masic, M. Buehler and O. Buyukozturk. Roadmap across the mesoscale for durable and sustainable cement paste - a bioinspired approach. *Construction and Building Materials* 2016; 115: 13-31.
 - 39) K. Kupwade-Patil, M. Tyagi, C. Brown and O. Buyukozturk. Water dynamics in Cement Paste at Early Age prepared with Pozzolanitic Volcanic Ash and Ordinary Portland Cement using Quasielastic Neutron Scattering. *Cement and Concrete Research* 2016; 86: 55-62.
 - 40) K. Kupwade-Patil, A. F. Al-Aibani, M. F. Abdulsalam, C. Mao, A. Bumajdad, S. D. Palkovic and O. Buyukozturk. Microstructure of cement paste with natural pozzolanitic volcanic ash and Portland cement at different stages of curing. *Construction and Building Materials* 2016; 113: 423-441.
 - 41) Wadhwa, H.-Y. Wu, A. Davis, M. Rubinstein, E. Shih, G. J. Mysore, J. G. Chen, O. Buyukozturk, J. V. Guttag, W. T. Freeman and F. Durand. Eulerian video magnification and analysis. *Communications of ACM* 2016; 60(1): 87-95.
 - 42) Y.-J. Cha, P. Trocha and O. Buyukozturk. Field measurement based system identification and dynamic response prediction of a unique MIT building. *Sensors* 2016; 16(7): 1016.

- 43) H. Sun and O. Buyukozturk. Probabilistic updating of building models using incomplete modal data. *Mechanical Systems and Signal Processing* 2016; 75: 27-40.
- 44) R. Mohammadi Ghazi and O. Buyukozturk. Damage detection with small data set using energy-based nonlinear features. *Structural Control and Health Monitoring* 2016; 23(2): 333-348.

2015 and selected earlier journal papers

- 45) S. D. Palkovic, S. Moeini, S. Yip and O. Buyukozturk. Mechanical behavior of a composite interface: Calcium-silicate-hydrates. *Journal of Applied Physics* 2015; 118(3): 034305.
- 46) H. Sun and O. Buyukozturk. Optimal sensor placement in structural health monitoring using discrete optimization. *Smart Materials and Structures* 2015; 24(12): 125034.
- 47) H. Sun and O. Buyukozturk. Identification of traffic-induced nodal excitation of truss bridges through heterogeneous data fusion. *Smart Materials and Structures* 2015; 24(7): 075032.
- 48) Y.-J. Cha and O. Buyukozturk. Structural Damage Detection Using Modal Strain Energy and Hybrid Multiobjective Optimization. *Computer-Aided Civil and Infrastructure Engineering* 2015; 30(5): 347-358.
- 49) J. G. Chen, N. Wadhwa, Y.-J. Cha, F. Durand, W. T. Freeman and O. Buyukozturk. Modal Identification of Simple Structures with High-Speed Video using Motion Magnification. *Journal of Sound and Vibration* 2015; 345: 58-71.
- 50) J. G. Chen, R. W. Haupt and O. Buyukozturk. Operational and Defect Parameters Concerning the Acoustic-Laser Vibrometry Method for FRP-reinforced Concrete. *NDT&E International* 2015; 71: 43-53.
- 51) Dindar, C. Yalcin, E. Yuksel, H. Ozkaynak and O. Buyukozturk. Development of Earthquake Energy Demand Spectra. *Earthquake Spectra* 2015; 31(3): 1667-1689.
- 52) D. Lau, K. Broderick, M. J. Buehler and O. Buyukozturk. A robust nano-scale experimental quantification of fracture energy in a bi-layer material system. *Proceedings of the National Academy of Sciences of the United States of America - PNAS* 2014; 111(33): 11990-11995.
- 53) M. Celebi, N. Toksoz and O. Buyukozturk. Rocking behavior of an instrumented unique building on the MIT campus identified from ambient shaking data. *Earthquake Spectra* 2014; 30(2): 704-720.
- 54) Chen, J. G., Haupt, R. W., & Büyüköztürk, O. The Acoustic-laser Vibrometry Technique for the Noncontact Detection of Discontinuities in Fiber Reinforced Polymer-retrofitted Concrete. *Materials Evaluation* 2014; 72(10), 1295-1303.
- 55) Gunes, D. Lau, C. Tuakta and O. Buyukozturk. Ductility of FRP-concrete systems: Investigations at different length scales. *Construction and Building Materials* 2013; 49: 915-925.
- 56) D. Lau, O. Buyukozturk and M. J. Buehler. Characterization of the adhesive strength between epoxy and silica using a free energy approach. *Journal of Materials Research* 2012; 27(14): 1787-1796.
- 57) T. Emge and O. Buyukozturk. Remote Nondestructive Testing of Composite-steel Interface by Acoustic Laser Vibrometry. *Materials Evaluation* 2012; 70(12): 1401-1410.
- 58) C. Tuakta and O. Buyukozturk. Conceptual Model for Prediction of FRP/Concrete Bond Strength under Moisture Cycles. *Journal of Composites for Construction* 2011; 15 (5): 743-756.
- 59) O. Buyukozturk, M. J. Buehler, D. Lau and C. Tuakta. Structural Solution Using Molecular Dynamics: Fundamentals and a Case Study of Epoxy-Silica Interface. *International Journal of Solids and Structures* 2011; 48(14-15): 2131-2140.
- 60) C. Tuakta and O. Buyukozturk. Deterioration of FRP/concrete bond system under variable moisture conditions quantified by fracture mechanics. *Composite Part B: Engineering* 2011; 42(2): 145-154.
- 61) D. Lau and O. Buyukozturk. Fracture Characterization of Concrete/Epoxy Interface Affected by Moisture. *Mechanics of Materials* 2010; 42(12): 1031-1042
- 62) O. Büyüköztürk, O. Gunes and E. Karaca. Progress on understanding debonding problems in reinforced concrete and steel members strengthened using FRP composites. *Construction and Building Materials* 2004; 18(1): 9-19.

- 63) H.C. Rhim and O. Büyüköztürk. Electromagnetic properties of concrete at microwave frequency range. *Materials Journal* 1998; 95(3): 262-271.
- 64) O. Büyüköztürk. Imaging of concrete structures. *NDT & E International* 1998; 31(4): 233-243.