

HOMIN SONG

Postdoctoral Appointee
Decision and Infrastructure Sciences Division
Argonne National Laboratory

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RESEARCH INTERESTS

Machine Learning; Artificial Intelligence; Nondestructive Evaluation; Structural Health Monitoring; Wave Mechanics; Ultrasonics; Elastodynamics; Heat transfer; Signal/image Processing; Compressed Sensing; Inhomogeneous Materials.

EDUCATION

Ph.D.	Civil Engineering The University of Illinois at Urbana-Champaign (UIUC), USA <i>Dissertation title: Nondestructive damage characterization of concrete and concrete-steel composites using contactless ultrasonic scanning</i> (Advisor: Prof. John S. Popovics)	2014 – 2019
M.S.	Civil and Environmental Engineering Korea Advanced Institute of Science and Technology (KAIST), KOREA <i>Thesis title: Dual piezoelectric transducer-based electromechanical impedance measurement for health monitoring of large structures</i> (Advisor: Prof. Hoon Sohn)	2011 – 2013
B.S.	Civil and Environmental Engineering Hanyang University (HYU), KOREA <i>Summa Cum Laude</i> graduate	2005 – 2011

PROFESSIONAL EXPERIENCE

Postdoctoral Appointee	Decision and Infrastructure Sciences Division Argonne National Laboratory (ANL), USA (Advisor: Dr. Yongchao Yang, currently at Michigan Tech)	2019 May – Pres.
Graduate Intern	Nuclear Science and Engineering Division Argonne National Laboratory (ANL), USA	2018 Dec. – 2019 Mar.
Teaching Assistant	<i>Behavior of Materials (CEE 300/TAM 324)</i> Department of Civil and Environmental Engineering University of Illinois at Urbana-Champaign (UIUC), USA	2018 Aug. – Dec.
Teaching Assistant	<i>Infrastructure NDE Methods (CEE 504)</i> Department of Civil and Environmental Engineering University of Illinois at Urbana-Champaign (UIUC), USA	2018 Jan. – May
Research Assistant	Department of Civil and Environmental Engineering University of Illinois at Urbana-Champaign (UIUC), USA	2014 – 2018
Invited Researcher	HK (Hyundai Heavy Industries - KAIST) Research Center Korea Advanced Institute of Science and Technology (KAIST), KOREA	2013 – 2014
Research Assistant	Department of Civil and Environmental Engineering Korea Advanced Institute of Science and Technology (KAIST), KOREA	2011 – 2013

HONORS & AWARDS

IWSHM Student Best Paper Award

2017

The 11th International Workshop on Structural Health Monitoring;

The title of the awarded paper is “Characterization of distributed cracks in concrete using randomly scattered ultrasonic wavefield extraction.”

ACI-James Instrument Student Award for Research on NDT of Concrete

2016

American Concrete Institute (ACI) Committee 228 and James Instruments, Inc.(sponsor);

The title of the awarded paper is “Investigation of concrete setting and hardening using leaky Rayleigh wave measurements.”

KSCE Outstanding Paper Award

2012

The 38th Korean Society of Civil Engineers (KSCE) Annual Conference;

The title of the awarded paper is “Development of a dual PZT based electromechanical impedance measurement technique for structural health monitoring.”

JOURNAL PUBLICATIONS ([Google Scholar](#))

* 8 published and 2 submitted.

* The corresponding author is underlined.

Published

Homin Song and John S. Popovics, Extracting non-propagating oscillatory fields in concrete to detect distributed cracking, *Journal of Acoustical Society of America*, 146(4): 2655-2670, 2019.

Homin Song and John S. Popovics, Contactless ultrasonic wavefield imaging to visualize near-surface damage in concrete elements, *Applied Sciences*, 9(15): 3005, 2019.

Dong Kook Woo, **Homin Song** and Praveen Kumar, Mapping subsurface tile drainage systems with thermal images, *Agricultural Water Management*, 218:94-101, 2019.

Homin Song and John S. Popovics, Characterization of steel-concrete interface bonding conditions using attenuation characteristics of guided waves, *Cement and Concrete Composites*, 83: 111-124, 2017.

Suyun Ham, **Homin Song**, Michael Oelze and John S. Popovics, A noncontact ultrasonic surface wave approach to characterize distributed cracking damage in concrete, *Ultrasonics*, 75: 46-57, 2017.

Homin Song, Hyung Jin Lim, Sangmin Lee, Hoon Sohn, Wonjun Yun and Eunha Song, Automated detection and quantification of hidden voids in triplex bonding layers using active lock-in thermography, *NDT&E International*, 74: 94-105, 2015.

Yun-Kyu An, **Homin Song** and Hoon Sohn, Wireless ultrasonic wavefield imaging via laser for hidden damage detection inside a steel box-girder bridge, *Smart Materials and Structures*, 23(9): 095019, 2014.

Homin Song, Hyung Jin Lim and Hoon Sohn, Electromechanical impedance measurement from large structures using a dual piezoelectric transducer, *Journal of Sound and Vibration*, 332 (25): 6580-6596, 2013.

Submitted

Homin Song and Yongchao Yang, Super-resolution ultrasonic array imaging of subwavelength defects via deep learning, submitted to *Mechanical Systems and Signal Processing*, 2019.

Homin Song and Yongchao Yang, Noncontact super-resolution guided wave array imaging of subwavelength defects using a multi-scale deep learning approach, submitted to *Structural Health Monitoring*, 2019.

PEER-REVIWED ARTICLES

* The corresponding author is underlined.

Hajin Choi, **Homin Song**, Quang N.V. Tran, Jeffery R. Roesler and John S. Popovics, Contactless ultrasonic system for continuous monitoring of concrete stiffening and setting, *Concrete International*, 38(9): 35-41, 2016.

CONFERENCE PROCEEDINGS

Homin Song and John S. Popovics, Characterization of distributed cracks in concrete using randomly scattered wavefield extraction, *The 11th International Workshop on Structural Health Monitoring*, Stanford, CA, United States, September 12-14, 2017.

Homin Song and John S. Popovics, Development of an automated contactless ultrasonic scanning measurement system for wavefield imaging of concrete elements, *2017 IEEE International Ultrasonic Symposium*, Washington, D.C., United States, September 6-9, 2017.

Homin Song and John S. Popovics, Hidden disbond detection in spent nuclear storage systems using air-coupled ultrasonics, *SPIE Smart Structures/NDE*, Las Vegas, NV, United States, March 20-24, 2016.

Homin Song, Hyung Jin Lim and Hoon Sohn, Development of a dual PZT based electromechanical impedance measurement technique for structural health monitoring, *The 38th Korean Society of Civil Engineers Annual Conference*, Gwangju, Korea, Oct 24-26, 2012.

Yun Kyu An, **Homin Song**, Hyun Jun Park, Hoon Sohn and Chung Bang Yun, Remote guided wave imaging using wireless PZT excitation and laser vibrometer scanning for local bridge monitoring, *The 6th International Conference on Bridge Maintenance, Safety and Management*, Lake Como, Italy, July 8-12, 2012.

Hyung Jin Lim, **Homin Song** and Hoon Sohn, Development of dual PZT based impedance measurement techniques for large-scale structures, *The 6th European Workshop on Structural Health Monitoring*, Dresden, Germany, July 3-6, 2012.

INVITED SEMINAR TALKS

Homin Song, Full-field high-resolution ultrasonic imaging for nondestructive evaluation and structural health monitoring, Graduate Seminar Speaker Series, Michigan Technological University, Houghton, MI, USA, Jan. 23, 2020.

Homin Song, Nondestructive damage characterization of concrete and steel-concrete composites using noncontact ultrasonic scanning, University of Utah, Salt Lake City, UT, USA, Dec. 2, 2019.

Homin Song, Nondestructive material damage characterization using contactless scanning ultrasound and lock-in thermography, Argonne National Laboratory, Lemont, IL, USA, Sep. 20, 2018.

Homin Song, Investigation of multiple scattering behaviors of surface waves to characterize distributed cracks in concrete, School of Urban and Environmental Engineering, Ulsan National Institute of Science and Technology (UNIST), Ulsan, South Korea, Jan. 4, 2018.

Hajin Choi, **Homin Song**, Quang N.V. Tran and John S. Popovics, Investigation of concrete setting and hardening using leaky Rayleigh wave measurements, *ACI 228 Committee meeting*, Milwaukee, WI, United States, April 19, 2016.

CONFERENCE PRESENTATIONS

Homin Song and Yongchao Yang, Full-field high-resolution ultrasonic imaging via noncontact ultrasonic scanning measurements and machine learning, *2019 ANL Postdoctoral Research and Career Symposium*, Lemont, IL, USA, Nov. 7, 2019.

John S. Popovics and **Homin Song**, Detection of ASR damage in concrete using contactless ultrasonic scanning, *The 46th Review of Progress in Quantitative Nondestructive Evaluation 2019*, Portland, OR, USA, July 18, 2019.

Sai Kalyan Evani, John S. Popovics and **Homin Song**, Reciprocal ultrasonic measurements for damage detection in concrete, *AmeriMech Symposium: Non-reciprocal and Topological Wave Phenomenon in Solids and Fluids*, Columbia, MO, USA, May 30, 2019

Homin Song, John S. Popovics and Steven B. Feldman, Contactless visualization and characterization of alkali-silica reaction (ASR) damage in concrete using multiply scattered ultrasonic wavefields, *ASNT's NDE/NDT for Highway and Bridges: Structural Materials Technology (SMT 2018) and the International Symposium Non-Destructive Testing in Civil Engineering (NDT-CE 2018)*, New Brunswick, NJ, USA, Aug. 28, 2018.

Homin Song and John S. Popovics, Characterization of distributed cracks in concrete using randomly scattered wavefield extraction, *The 11th International Workshop on Structural Health Monitoring*, Stanford, CA, USA, Sep. 13, 2017.

Homin Song and John S. Popovics, Contactless ultrasonic wavefield imaging of concrete elements using an automated scanning MEMS ultrasonic sensor array, *2017 IEEE International Ultrasonic Symposium*, Washington, DC, USA, Sep. 8, 2017.

Homin Song and John S. Popovics, Characterizing distributed cracks in concrete using multiple scattering behavior of surface waves, *The 44th Review of Progress in Quantitative Nondestructive Evaluation 2017*, Provo, UT, USA, July 18, 2017.

Homin Song and John S. Popovics, Characterization of distributed cracking in concrete using contactless ultrasonic scanning, *ACI Fall Convention 2016*, Philadelphia, PA, USA, Oct. 25, 2016.

Homin Song and John S. Popovics, Hidden disbond detection in spent nuclear dry storage systems using air-coupled ultrasonics, *SPIE Smart Structures/NDE*, Las Vegas, NV, USA, Mar. 24, 2016.

Homin Song, Hyung Jin Lim and Hoon Sohn, Development of a dual PZT based electromechanical impedance measurement technique for structural health monitoring, *The 38th Korean Society of Civil Engineers Annual Conference*, Gwangju, Korea, Oct. 26, 2012.

RESEARCH PROJECTS

DARPA Physics of Artificial Intelligence (PAI) Program, US Department of Defense (DoD) 2018 – Pres.
Making physical sense of machine learning: Full-field high-resolution imaging of structural dynamics
I have been developing a deep learning-based super-resolution ultrasonic imaging technique to characterize subwavelength defects in solid media.

National Institute of Standards and Technology (NIST), US Department of Commerce (DoC) 2017 – 2018
Nondestructive evaluation techniques for assessing alkali-silica reaction (ASR) degradation of concrete consortium
My advisor and I (Univ. of Illinois team) have been invited to this consortium and collaborating with the Inorganic Materials Group and the Structures Group. I have applied my noncontact ultrasonic testing method to large-scale concrete samples housed at the ASR testbed at NIST and established the feasibility of the method.

Nuclear Energy University Program (NEUP), US Department of Energy (DoE) 2015 – 2018
Multisensory robotic system for used nuclear fuel dry storage casks
I have developed advanced nondestructive inspection methods for detecting and characterizing damage in spent nuclear fuel dry storage systems, based on noncontact ultrasonics and frequency-wavenumber domain signal processing approaches. A 10-minute project video report can be accessed [here](#).

Hyundai Heavy Industries Co. LTD 2013 – 2014
Development of automated non-destructive inspection system for damage detection of triplex adhesive layers
I have developed a noncontact hidden void visualization system for triplex bonding layers in LNG carrier ships.

Hyundai Motor Company 2012 – 2013
Development of smart sensing technology for equipment abnormality detection

I conducted experiments applying electromechanical impedance-based and guided wave-based techniques to in-service motors for detection of bolt-loosening and inner race cracks under varying environmental conditions.

Korea Ministry of Land, Transportation and Maritime Affairs

2011 – 2013

Ubiquitous and ecology city development

I have developed a new electromechanical impedance technique (called “Dual PZT impedance technique”) and applied it to *in-situ* bridge and building structures.

POSCO Corporation

2011

Development of smart steel members for online steel structure monitoring

I conducted experiments applying a guided wave-based damage detection technique to steel members for crack detection under varying temperature and loading conditions.

TEACHING EXPERIENCE

Teaching Assistant	CEE300/TAM324 Behavior of Materials I led the lab session of the class and graded the submitted lab reports during the entire semester. In the weekly lab sessions, I did the experimental demonstration of several material testing methods including tension/compression tests and fracture toughness test. I also interacted with students every week during TA office hours. At the end of the semester, I received 4.1/5.0 on average in the students' evaluation for TA's teaching effectiveness.	2018 Aug. – Dec.
Guest Lecturer	CEE504 Infrastructure NDE Methods I gave two lectures in place of the instructor (John S. Popovics) on the following topics: (1) Mechanical wave propagation and ultrasonic testing; and (2) Electromagnetic wave propagation and the ground penetration radar (GPR) method.	2018 Jan. 29 Mar. 26
Teaching Assistant	CEE504 Infrastructure NDE Methods I led the lab session of the class and graded the submitted individual lab reports and group task reports during the entire semester. I gave short lectures at weekly lab sessions and did the experimental demonstration of several NDE methods including ultrasonic, electromagnetic and electrochemical testing. I also interacted with students every week during TA office hours. At the end of the semester, I received 4.9/5.0 on average in the students' evaluation for TA's teaching effectiveness.	2018 Jan. – May
Laboratory Assistant	Asia-Pacific Summer School (APSS) on Smart Structures Technology I taught students how to experimentally estimate corrosion rate. The demonstrated techniques include half-cell potential, linear polarized resistance, concrete surface resistivity and potential measurements.	2015 Aug.
Guest Lecturer	Guest lecture session in the class of CEE598WP Wave Propagation I gave a lecture on quantitative defect visualization using an active lock-in thermography technique.	2014 Oct.
Student Lecturer	Student lecture sessions in the class of CEE598WP Wave Propagation I gave three lectures on the following topics: (1) Phase, group and energy velocities; (2) Wave scattering and dispersion; and (3) Nonlinear wave propagation. For each lecture, I gave a homework assignment to students and graded the submitted assignments.	2014 Sep. – Oct.

PROFESSIONAL SERVICES

Journal Reviewer	Journal of Nondestructive Evaluation; Cement and Concrete Composites; Sensors; Transportation Research Record; Journal of the Transportation Research Board.
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Associate American Concrete Institute (ACI) Committees:
Committee 228 Nondestructive Testing;
Member 444 Structural Health Monitoring.

PROFESSIONAL SOCIETY MEMBERSHIPS

American Concrete Institute (ACI); American Society of Civil Engineers (ASCE); American Society of Mechanical Engineers (ASME); American Society for Nondestructive Testing (ASNT); International Society for Optics and Photonics (SPIE); Institute of Electrical and Electronics Engineers (IEEE); IEEE Ultrasonics, Ferroelectrics, and Frequency Control Society.

SCHOLARSHIPS & TRAVEL GRANTS

Conference Travel Awards for Graduate Students 2017
The Graduate College of the University of Illinois at Urbana-Champaign

IEEE Student Travel Award 2017
2017 IEEE International Ultrasonic Symposium;
The title of the awarded paper is “Contactless ultrasonic wavefield imaging of concrete elements using an automated scanning MEMS ultrasonic sensor array.”

Conference Travel Awards for Graduate Students 2016
The Graduate College of the University of Illinois

Scholarships for Outstanding Students 2008 – 2010
Hanyang University

Scholarships for Outstanding Students 2009
Korea Student Aid Foundation