

# Soobum Lee\*

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## RESEARCH INTERESTS

Vibration Energy Harvester Design (Piezoelectric/Electromagnetic)  
Structural Topology and Shape Design Optimization  
Reliability Based Design Optimization  
Computer Aided Design / Finite Element Method

## PROFESSIONAL EXPERIENCE

**Associate Professor** (Jul. 2019 – Present)

**Assistant Professor** (Nov. 2012 – Jun. 2019)

Mechanical Engineering, *University of Maryland Baltimore County, Baltimore USA*

- Researching practical piezoelectric energy harvesting systems utilizing broadband frequency and random vibration.
- Developing an intelligent and energy sustainable electromagnetic energy harvesting systems utilizing kinematic/rotational energy.
- Researching topology optimization for additive manufacturability and flexural mechanism design.

**Research Assistant Professor** (Sep. 2011 – Sep. 2012)

Aerospace and Mechanical Engineering, *University of Notre Dame, Notre Dame USA*

- Researched robust design of nano/microscale ceramic material for high-temperature application with the uncertainties of operating condition and material properties under consideration (Supported by AFOSR).
- Researched tall building sculpting and structure design subject to aerodynamic load for structural safety and wind energy harvesting.

**Postdoctoral Research Associate / Lecturer** (Jul. 2010 – Sep. 2011)

Aerospace and Mechanical Engineering, *University of Notre Dame, Notre Dame USA*

- Developed the topology optimization method for piezoelectric energy harvester using hybrid cellular automata algorithm.
- Researched tall building structure design subject to aerodynamic load for structural safety and wind energy harvesting.

**Postdoctoral Fellow** (Jan. 2008 – Jun. 2010)

Mechanical Engineering, *University of Maryland, College Park USA*

- Designed a new piezoelectric energy harvester named *segment-type energy harvester* for utilization of multimodal vibration from building HVAC system. Increased efficiency by 30% after design optimization using MATLAB and ANSYS, fabricated prototype, and successfully integrated with a

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\*As of 6/10/2018

wireless temperature sensor for real-time room temperature monitoring.

- Proposed a new practicable conceptual design of energy harvesting device – *energy harvesting skin*. Obtained the optimal design for utilizing outdoor unit vibration, and proved excellent power harvesting capability up to 4mW (sufficient power to operate for structural health monitoring wireless sensor).

**Researcher**

(Feb. 2007 – Dec. 2007)

*KAERI (Korea Atomic Energy Research Institute), Daejeon Korea*

- Developed the design procedure of a spacer grid in a nuclear fuel assembly for impact strength improvement up to 20% using experimentally verified ABAQUS FE model.
- Researched a hot gas duct design for nuclear hydrogen generation.

**Visiting Researcher, Teaching Assistant**

(Nov. 2004 – Mar. 2005)

*Queen's University, Kingston Canada*

- Researched the design optimization of hip implant using topology optimization methodology to reduce weight by 20% with the same strength.

**Researcher, Teaching Assistant**

(Mar. 2000 – Feb. 2004)

*KAIST, Daejeon Korea*

- Developed a 3D CAD-based structural design optimization software through the research project granted by Korean Ministry of Science and Technology (MOST) and Hyundai Motor Company. Achieved CAD-based structural design optimization for more than 10 case studies including the natural frequency improvement of an automobile engine mount bracket by 61%, and the stress reduction of an excavator boom by 20%.
- Developed a shipyard cramework simulator through the research project granted by Hyundai Heavy Industry. Facilitate various cramework scenarios' animation, dynamic stress analysis in a shipblock, and design optimization on stiffener location for stress reduction up to 38%.

**Visiting Researcher**

(Jul. 2001 – Aug. 2001)

*AIST (National Institute of Advanced Industrial Science and Technology), Tsukuba Japan*

- Build the mesh adaptation code in FE analysis for 3-dimensional case.

## EDUCATION

**Ph.D. Mechanical Engineering**, KAIST, Korea; Mar. 2000 – Aug. 2007 (Advisor: Prof. Byung Man Kwak)

“Smooth Boundary Topology Optimization Using B-spline and Hole Generation”

**M.S. Mechanical Engineering**, KAIST, Korea; Mar. 1998 – Feb. 2000

“A CAD-based Software for Simulation of Lifting and Turnover of Ship Block”

**B.S. Mechanical Design & Production Engineering**, Yonsei University, Korea; Mar. 1994 – Feb. 1998

## TEACHING EXPERIENCE

**ENME360 Vibrations**, 2017 – Present, University of Maryland Baltimore County

Required course for UMBC ME undergraduate, about 90 enrollments per term

**ENME610 Design optimization with Engineering Application**, 2014 – Present, University of Maryland Baltimore County

Firstly developed in UMBC for Engineering graduate, about 10 enrollments per term

**ENME204 Introduction to Design with CAD**, 2013 – Present, University of Maryland Baltimore County

Required course for UMBC ME undergraduate, about 120 enrollments per year. Introduced 3D printing in fundamental engineering design process

**AME60661 Optimum Design of Mechanical Elements**, Spring 2011, University of Notre Dame

**Advanced Methods in Risk-Based Design** (Substitute lecturer), Spring 2008, 2009, University of Maryland

**Mathematical Techniques of Reliability** (Substitute lecturer, 6 classes), Spring 2009, University of Maryland

**Computer Aided Design** (Invited lecturer, 3 classes), Fall 2004, Queen's University

**Optimal Design** (Invited lecturer), Spring 2004, KAIST

**Engineering Design (Capstone Design)** (Teaching Assistant), Spring 2003, KAIST

**Foundation on Stress Analysis** (Teaching Assistant), Spring 2001, KAIST

**Mechanical Engineering Laboratory** (Teaching Assistant), Fall 2002, KAIST

### AWARDS

**Highlight of 2009** (One of 23 highlights out of 300 publications), Smart Materials and Structures, Institute of Physics and IOP Publishing Ltd., "Robust Segment-Type Energy Harvester and Its Application to a Wireless Sensor," 2010

**Best paper prize**, CAE department, The Korean Society of Mechanical Engineering (KSME) Annuals Spring & Fall Conference, "Impact analysis of the spacer grid assembly for PWR fuels(III)," Busan, Korea, 2007

**Graduate student scholarship**, KAIST, 1998-1999, 2000-2004

**Honor student**, Yonsei University, 1994, 1995

### GRANTS

**S. Lee (PI)**, "ActiveCharge™: a Magnet-Driven Piezoelectric Energy Harvester for Wind Turbine Monitoring," **TEDCO Maryland Innovation Initiative (MII) Program, Phase III**, \$150,000 (Lee's portion: 100%), Aug. 2019 – May. 2019

**S. Lee (PI)**, "Topology Optimization of Wind Tunnel Force Balance," **National Aeronautics and Space Administration**, \$89,077 (Lee's portion: 100%), Feb. 2019 – Dec. 2019

**S. Lee (PI)**, "ActiveCharge™: an Impact-Driven Piezoelectric Energy Harvester," **TEDCO Maryland Innovation Initiative (MII) Program, Phase I-II**, \$115,000 (Lee's portion: 100%), Jan. 2018 – Sep. 2018

**S. Lee (PI)**, "Force sensing dental bracket design" **UMBC Supplement for Undergraduate Research Experiences (SURE) Award**, \$1,500 (Lee's portion: 100%), Sep. 2017 – Mar. 2018

**S. Lee (PI)**, "Study on Fault Prediction Technique Considering Physical Characteristics," **Seoul Metro Research Grant** (subcontracted by KAIEM Co. Ltd.), \$43,000 (Lee's portion: 100%), Sep. 2017 – Dec. 2017

**S. Lee (PI)**, "Development of core technologies for manufacturing and commercializing laboratory weighing scale with 100 million resolution," **Korea Institute for Advancement of Technology (KIAT) World Class 300 Program**, \$97,000 (Lee's portion: 100%), Jan. 2017 – Dec. 2017

**S. Lee (PI)**, "Electromagnetic Energy Harvester for Self-charging Wind Turbine Monitoring Sensor," **UMBC Technology Catalyst Fund**, \$10,000 (Lee's portion: 100%), Jan. 2017 – Sep. 2017

**S. Lee (PI)**, "Prototype development of a practicable nonlinear vibration energy harvester" **UMBC Supplement for Undergraduate Research Experiences (SURE) Award**, \$1,500 (Lee's portion: 100%), Sep. 2016 – Mar. 2017

**S. Lee (PI)**, M. A. Melo (Co-PI), "A Biocompatible and Implantable Dental Energy Harvesting Prototype for Self-Powering Brain Stimulator," **UMB-UMBC Research and Innovation partnership Grant Program**, \$50,000 (Lee's portion: 52%), Jul. 2016 – Sep. 2017

- M. Younis (PI), **S. Lee**, S. Kim, W. Zhu (Co-PI), “Prototype Development for a Networked Multi-modal Sensor System for Autonomous, Non-intrusive, and Self-sustained Pipeline Monitoring,” *UMBC COEIT Strategic Plan Implementation Grant Program*, \$40,000 (Lee’s portion: 40%), Feb. 2016 – Feb. 2017
- S. Lee** (PI), “Design Optimization of Tire Vibration Energy Harvesting Device for Self-Powering Operation of Tire Monitoring Sensor” *Korea Institute of Machinery and Materials*, \$36,976 (Lee’s portion: 100%), Jan. 2015 – Dec. 2015
- S. Lee** (PI), “Energy Harvesting Buoy System as a Charging Station for UAVs” *UMBC Undergraduate Research Assistantship Support (URAS) Award*, \$1,500 (Lee’s portion: 100%), Jan. 2015 – Jun. 2015
- S. Lee** (PI), “Aircraft Subsystem Packaging Design Using Two-Step Multifunctional Design Optimization Methodologies,” *US Air Force Summer Faculty Fellowship*, \$22,436 (Lee’s portion: 100%), Jun. 2014 – Aug. 2014
- S. Lee** (PI), “A Durable Nonlinear Vibration Energy Harvester Design for Reliable and Battery-free Wireless Sensor Operation,” *UMBC Special Research Assistantship/Initiative Support*, \$19,954 (Lee’s portion: 100%), Aug. 2013 – Jul. 2014
- S. Lee** (PI), “Aircraft Subsystem Packaging Design Using Two-Step Multifunctional Design Optimization Methodologies,” *US Air Force Summer Faculty Fellowship*, \$11,152 (Lee’s portion: 100%), Jun. 2013 – Aug. 2013
- S. Lee** (PI), “Design Framework for Multifunctional Skin Structure for Condition Monitoring and Energy Harvesting,” *UMBC Summer Faculty Fellowship*, \$6,000 (Lee’s portion: 100%), Jun. 2013 – Aug. 2013
- S. Lee** (PI), “Design of Multifunctional Energy Harvesting Skin Under Stochastic Vibration and Application to Wireless Sensor Operation,” *National Research Foundation of Korea Grant* (NRF-2009-352-D00007), \$21,800 (Lee’s portion: 100%), Jul. 2009 – Jun. 2010.

## PATENTS

- S. Lee**, C. Lee, M. A. Melo, and R. Masri, “Orthodontic Measurement Device and Method,” Application No. 62/677706, Submitted Provisional Patent (U.S. only, May. 2018)
- S. Lee**, “A Method for Harvesting Broadband Vibration Energy from a Rotating Object Using Asymmetric Nonlinear Spring,” 62/548,492;62/677,825;PCT/US18/47505, 2018
- M. Song, H. Park, **S. Lee**, “Supporting Spacer Grid for Nuclear Fuel Rods or Cylindrical Tubes,” Korea Patent KR/10-1731915, 2017
- S. Lee**, “Bi-stable Vibration Energy Harvester,” US Provisional Patent Pending (Feb. 2015), University of Maryland Baltimore County (Application No. 62120996; Attorney Docket No: UMBC2014-020SL)
- S. Lee** and R. M. Masri, “A Novel Energy Harvesting Method to Self-Power Implanted Devices,” US Provisional Patent Pending (Jun. 2014), University of Maryland Baltimore County (UMBC Ref. No. 2014-014)
- S. Lee**, “Energy Harvesting Device Using Rotational Energy of Vehicle Wheel and Tire Pressure Monitoring System Using The Same,” Korea Patent KR/10-1310461, 2013
- S. Lee**, “A Method for Creating Electric Energy from the Circumference of a Rotating Object,” US Provisional Patent Pending (Jan. 2013), University of Maryland Baltimore County (App. No.: 61770544)
- S. Lee** and B. D. Youn, “Energy Harvesting Waist Belt,” US Provisional Patent Pending, US/61/505856 (Jul. 2011), University of Maryland (Atty Docket No.: PS-2009-028)

## PUBLICATIONS

### Web Article:

1. “Potomac’s High Precision Laser Micromachining Advances New Energy-Harvesting Technique at UMBC” at Potomac Photonics: <http://www.potomac-laser.com/blog/potomacs-high-precision-laser-micromachining-advances-new-energy-harvesting-technique-umbc/>
2. **Featured article**, “Energy harvesting skin generates power from air conditioners” at PhysOrg.com (Web-based science, research and technology news service, Global Top 2,000 Websites): <http://www.physorg.com/news/2011-04-energy-harvesting-skin-power-air.html>
3. “Don't let those A/C vibrations go to waste” at PowerElectronics.com (Web-based energy technology news service by Penton Media Inc.): <http://powerelectronics.com/energy-harvesting/dont-let-those-ac-vibrations-go-waste>

### Journal Papers:

1. R. Fan, **S. Lee**, H. Jung, M. A. Melo, R. Masri, “Piezoelectric energy harvester utilizing mandibular deformation to power implantable biosystems: a feasibility study,” J. Mech. Sci. Technol., Accepted for Publication, 2019
2. S. Nezami, **S. Lee**, J. Jin, and K. W. Kang “Shape optimization of railroad vibration energy harvester for structural robustness and power generation performance,” Eng. Struct., Vol. 173, No. 15, pp. 460-471, 2018
3. H. Jung, **S. Lee**, S. Jeong, and H. Yoo, “Segmented Impact-Type Piezoelectric Energy Harvester for Self-Start Impedance Matching Circuit,” Smart Mater. Struct. (IF: 2.909), In Press, 2018
4. N. Chen, T. Wei, D. Ha, H. Jung, and **S. Lee**, “Alternating Resistive Impedance Matching for an Impact-Type Micro Wind Piezoelectric Energy Harvester,” IEEE T. Ind. Electron., Vol. 65, No. 9, pp. 7374-7382, 2018
5. M. K. Sadoughi, M. Li, C. Hu, C. A. MacKenzie, **S. Lee**, and A. T. Eshghi, "A High-Dimensional Reliability Analysis Method for Simulation-Based Design Under Uncertainty." J. Mech. Design, 140.7: 071401, 2018
6. A. T. Eshghi, **S. Lee**, M. K. Sadoughi, C. Hu, Y. C. Kim, and J. H. Seo, "Design optimization under uncertainty and speed variability for a piezoelectric energy harvester powering a tire pressure monitoring sensor," Smart Mater. Struct., Vol. 26, No. 10, 105037, 2017
7. M. Sadoughi, C. Hu, C. A. MacKenzie, **S. Lee**, and A. Eshghi “A Maximum Expected Utility Method for Efficient Reliability Analysis of Complex Engineered Systems,” Struct. Multidiscip. O., p. 1-16, 2017
8. N. Chen, T. Wei, H. Jung, and **S. Lee**, “Quick self-start and minimum power-loss management circuit for impact-type micro wind piezoelectric energy harvesters,” Sensor. Actuat. A-Phys., Vol. 263, pp. 23–29, 2017
9. S. Seong, C. Hu, and **S. Lee**, “Design under Uncertainty for Reliable Power Generation of Nonlinear Piezoelectric Energy Harvester,” J. Intel. Mat. Syst. Str., 1045389X17689945, 2017
10. M. Bakhtiarinejad, **S. Lee**, and J. Joo, “Topology Optimization based on Morphing Mesh for Simultaneous Component Relocation and Frame Structure Design,” Struct. Multidiscip. O., DOI 10.1007/s00158-016-1468-4, 2016
11. P. Wang, Z. Wang, B. D. Youn, and **S. Lee**, “Reliability-based Robust Design of Smart Sensing Systems for Failure Diagnostics Using Piezoelectric Materials,” Compu. Struct., Vol. 156, pp. 110-121, 2015
12. **S. Lee** and F. Semperlotti, “Design Optimization for Passive Adaptive Structural Networks,” J. Intel. Mat. Syst. Str., Vol. 26, No. 9, pp. 1110-1127, 2015
13. **S. Lee** and A. Tovar, “Outrigger Placement in Tall Buildings Using Topology Optimization,” Eng. Struct., Vol. 74, No. 1, pp. 122-129, 2014

14. M. K. Kang, **S. Lee**, and J. H. Kim, "Shape Optimization of a Mechanically Decoupled Six-Axis Force/Torque Sensor," *Sensor. Actuat. A-Phys.*, Vol. 209, No. 1, pp. 41–51, 2014
15. **S. Lee** and D. H. Kim, "Durable and Sustainable Strap Type Electromagnetic Harvester for Tire Pressure Monitoring System," *J. Magnetics*, Vol. 18, No. 4, pp. 473-480, 2013
16. **S. Lee** and A. Tovar, "Topology Optimization of Energy Harvesting Skin Using Hybrid Cellular Automata," *J. Mech. Design*, Vol. 135, No. 3, pp. 031001 (11 pages), 2013
17. J. I. Park, **S. Lee**, and B. M. Kwak, "Design Optimization of Piezoelectric Energy Harvester Subject to Tip Excitation," *J. Mech. Sci. Technol.*, Vol. 26, No. 1, pp.137-143, 2012
18. **S. Lee** and B. D. Youn, "A New Piezoelectric Energy Harvesting Design Concept: Multimodal Energy Harvesting Skin," *IEEE T. Ultrason. Ferr.*, Vol. 58, No. 3, pp. 629-645, 2011
19. **S. Lee** and B. D. Youn, "A Design and Experimental Verification Methodology for Energy Harvester Skin Structure," *Smart Mater. Struct.*, Vol. 20, No. 5, 057001, 2011
20. B. C. Jung, D. H. Lee, B. D. Youn, and **S. Lee**, "A statistical characterization method for damping material properties and its application to structural-acoustic system design," *J. Mech. Sci. Technol.*, Vol. 25, No. 8, pp. 1893-1904, 2011
21. K. N. Song, **S. Lee**, M. K. Shin, J. J. Lee, and G. J. Park, "New Spacer Grid to Enhance Mechanical/Structural Performance," *J. Nucl. Sci. Technol.* Vol. 47, No. 3, pp. 295–303, 2010
22. **S. Lee**, B. D. Youn, and B. C. Jung, "Robust Segment-Type Energy Harvester and Its Application to a Wireless Sensor," *Smart Mater. Struct.*, Vol. 18, No. 9, 095021 (12pp), 2009 – *Selected as "Highlight of 2009" by the publisher*
23. K. N. Song, S. S. Kim, S. H. Lee, **S. Lee**, "Laser Welding Unit for Intersection Line Welding of Spacer Grid Inner Straps and its Application," *Journal of Laser Micro/Nanoengineering*, Vol. 4, No. 1, pp. 11-17, 2009
24. K. N. Song, S. S. Kim, **S. Lee**, Y. W. Kim, "Development of a LASER Welding Apparatus and a Method for an Inner-Strap Welding of a Spacer Grid Assembly for a PWR Fuel Assembly," *Mater. Sci. Forum*, Vol. 580-582 pp. 507~510, 2008
25. **S. Lee**, Y. W. Kim, and K. N. Song, "Parameter study of the dimple location in the spacer grid on the impact strength," *J. Mech. Sci. Technol.*, Vol. 22, pp. 2024~2029, 2008
26. D. H. Kim, **S. Lee**, B. M. Kwak, H. G. Kim, and D. A. Lowther, "Smooth boundary topology optimization for electrostatic problems through the combination of shape and topological design sensitivities," *IEEE Trans. Magn.*, Vol. 44, No. 6, pp. 1002-1005, 2008
27. C. H. Chung, **S. Lee**\*, B. M. Kwak, G. W. Kim, and J. H. Kim, "A delay line circuit design for crosstalk minimization using genetic algorithm," *IEEE T. Comput. Aid. D.*, Vol. 27, No. 3, pp. 578-583, 2008
28. **S. Lee**, and B. M. Kwak, "Smooth boundary topology optimization for eigenvalue performance and its application to design of flexural stage," *Eng. Optimiz.*, Vol. 40, No. 3, pp. 271-285, 2008
29. K. N. Song and **S. Lee**, "Performance analysis and test on the KAERI devised spacer grids for PWRs," *Journal of Power and Energy Systems*, Vol. 2, No. 1, pp. 47-56, 2008
30. K. N. Song, H. Y. Lee, Y. W. Kim, and **S. Lee**, "Preliminary Design Analysis of a Hot Gas Duct for the NHDD Program at Korea," *Adv. Mat. Res.*, Vol. 33-37, pp. 1227-1232, 2008
31. K. N. Song, S. H. Lee, and **S. Lee**, "Impact Analysis and Test for The Space Grid Assembly of a Nuclear Fuel Assembly," *Int. J. Mod. Phys. B*, Vol. 22, No. 9, 10, and 11 pp. 1228-1234, 2008
32. **S. Lee**, I. Y. Kim, and B. M. Kwak, "Smooth boundary topology optimization using B-spline and hole generation," *International Journal of CAD/CAM*, Vol. 7, No. 1, pp. 16-31, 2007
33. K. N. Song, **S. Lee**, and S. H. Lee, "Performance evaluation of new spacer grid shapes for PWRs," *Nucl. Eng. Technol.*, Vol. 39, No. 6, pp.737-746, 2007

34. **S. Lee** and B. M. Kwak, “Automatic generation of orthogonal arrays and its application to a two-step structural optimization,” Transactions of the KSME A, Vol. 27, No. 12, pp. 2047-2054, 2003 (in Korean)

#### **Conference Papers:**

1. H. Jung, S. Chervin, M. Smith, and **S. Lee**, “Design of an impact-driven piezoelectric energy harvester with gravity-induced rotator for wind turbine blade monitoring system (presentation only),” SPIE Smart Structures/Non-Destructive Evaluation (NDE) 2018, Denver, Colorado, USA, Mar. 2018
2. R. Fan, D. Joe, P. Shah, H. Jung, **S. Lee**, M. A. Melo, and R. Masri, “Design parameter study on piezoelectric energy harvester for scavenging human mandible deformation energy (presentation only),” SPIE Smart Structures/Non-Destructive Evaluation (NDE) 2018, Denver, Colorado, USA, Mar. 2018
3. A. Eshghi, **S. Lee**, M. K. Sadoughi, C. Hu, Y. C. Kim, and J. Seo, “Experimental verification of tire energy harvester designed via reliability based design optimization method,” SPIE Smart Structures/Non-Destructive Evaluation (NDE) 2018, Denver, Colorado, USA, Mar. 2018
4. H. Jung, **S. Lee**, H. Jabbar, S. Y. Jeong, and T. H. Sung, “Self-Start Piezoelectric Energy Harvesting Circuit with Adjustable UVLO Converter for Wireless Sensor Network,” ASME Conference on Smart Materials, Adaptive Structures and Intelligent Systems (SMASIS), Snowbird, UT, USA, Sep. 2017
5. A. Eshghi, **S. Lee**, and Y-C Kim, “Design under Uncertainty for a Piezoelectric Energy Harvester to Power a Tire Pressure Monitoring System,” Proceedings of the International Design Engineering Technical Conferences (IDETC), Cleveland, OH, USA, Aug. 2017
6. S. Nezami, **S. Lee**, and K-W Kang, “Design of Leaf Spring Structure to Improve Power and Structural Integrity of a Vibration Energy Harvester,” PHM Asian Pacific 2017, Jeju, Korea, July 2017
7. M. Sung, **S. Lee**, and N. Kim, “Simultaneous Optimization of Printing Angle and Geometry for Additive Manufacturing using Topology Optimization,” Proceedings of the 12th World Congress on Structural and Multidisciplinary Optimization (WCSMO12), 5 - 9 June 2017, Braunschweig, Germany
8. V. Dayal and **S. Lee**, “Air Curtain Development: An Energy-Harvesting Solution for Hinged Doors,” SPIE Smart Structures/Non-Destructive Evaluation (NDE) 2017, Portland, Oregon, USA, Mar. 2017
9. C. Mullen and **S. Lee**, “Experimental Verification and Optimization of a Linear Electromagnetic Energy Harvesting Device,” SPIE Smart Structures/Non-Destructive Evaluation (NDE) 2017, Portland, Oregon, USA, Mar. 2016
10. S. Nezami, **S. Lee**, K. Kang, and J. Kim, “Improving Durability of a Vibration Energy Harvester Using Structural Design Optimization,” ASME Conference on Smart Materials, Adaptive Structures and Intelligent Systems (SMASIS), Stowe, VT, USA, Sep. 2016
11. C. Mullen and **S. Lee**, “Optimization of an Electromagnetic Energy Harvesting Backpack under Actual Walking and Running Scenarios,” ASME Conference on Smart Materials, Adaptive Structures and Intelligent Systems (SMASIS), Stowe, VT, USA, Sep. 2016
12. K. Ahmed and **S. Lee**, “Mechanical Motion Conversion from Reciprocating Translation to One-Directional Rotation for Effective Energy Harvesting,” SPIE Smart Structures/Non-Destructive Evaluation (NDE) 2016, Las Vegas, USA, Mar. 2016
13. A. Eshghi, **S. Lee**, H. Lee, Y-C Kim, “Parameter Study and Optimization for Piezoelectric Energy Harvester for TPMS Considering Speed Variation,” SPIE Smart Structures/Non-Destructive Evaluation (NDE) 2016, Las Vegas, USA, Mar. 2016
14. M. Bakhtiarinejad, J. Joo, and **S. Lee**, “A New Topology Optimization Method for Simultaneous Design of Component Layout and Frame Structure of Aircraft Wing,” AIAA Science and Technology Forum and Exposition (SciTech) 2016, San Diego, USA, Jan. 2016

15. S. Seong, C. Mullen, and **S. Lee**, and C. Hu, "Reliability-Based Design Optimization for Nonlinear Energy Harvesters," ASME Conference on Smart Materials, Adaptive Structures and Intelligent Systems (SMASIS), Colorado Springs, CO, USA, Sep. 2015
16. **S. Lee**, N. Kim, and J. Joo, "Load-Path Design and Control Using Topology Optimization," 11th World Congress on Structural and Multidisciplinary Optimization, Sydney, Australia, Jun. 2015
17. S. Seong, **S. Lee**, and C. Hu, "Reliability-Based Design Optimization for Nonlinear Energy Harvesters," SPIE Smart Structures/Non-Destructive Evaluation (NDE) 2015, San Diego, USA, Mar. 2015
18. S. Seong and **S. Lee**, "Design of nonlinear energy harvester with snap-through buckling mechanism," Proceedings of the International Design Engineering Technical Conferences (IDETC), Buffalo, NY, USA, Aug. 2014
19. **S. Lee**, C. Dibernardo and A Tovar, "Outrigger system design of tall building using topology optimization," 8th China-Japan-Korea Joint Symposium on Optimization of Structural and Mechanical Systems, Gyeongju, Korea, May 2014
20. **S. Lee** and F. Semperlotti, "Optimal synthesis of passive adaptive structural networks for damping and stiffness improvement," SPIE Smart Structures/Non-Destructive Evaluation (NDE) 2014, San Diego, USA, Mar. 2014
21. M. Kang, **S. Lee** and J. Kim, "Optimal design of a mechanically decoupled six-axis force/torque sensor based on the principal cross coupling minimization," SPIE Smart Structures/Non-Destructive Evaluation (NDE) 2014, San Diego, USA, Mar. 2014
22. A. T. Almaktoom, Z. Wang, P. Wang, and **S Lee**, "Smart Sensing Function Design Using Multifunctional Material for Failure Diagnostics and Prognostics," 10th World Congress on Structural and Multidisciplinary Optimization, Orlando, USA, May 2013
23. **S. Lee**, "A Durable and Sustainable Strap Type Electromagnetic Harvester for TPMS," Sensor Expo & Conference, Chicago, USA, Jun. 2012
24. **S. Lee**, K. Khadke, A. Tovar, "Uncertainty Propagation and Stochastic Sensitivity Analysis for Ceramic Composite Material Design Optimization," Joint Conference of the Engineering Mechanics Institute and 11th ASCE Joint Specialty Conference on Probabilistic Mechanics and Structural Reliability (EMI/PMC), Notre Dame, USA, Jun. 2012
25. **S. Lee**, S. Bobby, A. Tovar, A. Kareem, S. M. J. Spence, "Shape and Topology Sculpting of Tall Buildings under Aerodynamic Loads," Proceedings of ASCE Structures Congress, Chicago, USA, Mar. 2012
26. **S. Lee** and A. Tovar, "Topology Optimization of Energy Harvesting Skin Structure Utilizing Harmonic Vibration," Proceedings of the International Design Engineering Technical Conferences (IDETC), Washington D.C., USA, Aug. 2011
27. **S. Lee**, A. Tovar, J. E. Renaud, and A. Kareem, "Topological Optimization of Building Structural Systems and their Shape Optimization under Aerodynamic Loads," Proceedings of the 13th International Conference on Wind Engineering, Amsterdam, The Netherlands, Jul. 2011
28. **S. Lee** and B. D. Youn, "Multimodal Energy Harvesting Skin Using Piezoelectric Unimorph Shell Structure," Proceedings of the 18th International Conference on Composite Materials, Jeju, Korea, Aug. 2011
29. **S. Lee**, B. D. Youn, and M. Giraud, "Designing Energy Harvesting Skin Structure Utilizing Outdoor Unit Vibration," Proceedings of the ASME International Design Engineering Technical Conferences (IDETC), Montreal, Quebec, Canada, Aug. 2010
30. **S. Lee**, and B. D. Youn, "A New Energy Harvesting Design Concept: Multimodal Energy Harvesting Skin," Proceedings of the AIAA/ISSMO Multidisciplinary Analysis and Optimization (MAO), Fort



Worth, TX, USA, Aug. 2010

31. **S. Lee**, B. D. Youn, and B. C. Jung, "Robust Segment-Type Energy Harvester Powering Wireless Sensor for Building Automation," Proceedings of the International Design Engineering Technical Conferences (IDETC), San Diego, CA, USA, Aug. 2009
32. **S. Lee** and B. D. Youn, "Computer Model Calibration and Design Comparison on Piezoelectric Energy Harvester," Proceedings of the 12th AIAA/ISSMO Multidisciplinary Analysis and Optimization Conference, Victoria, British Columbia Canada, 2008
33. K. N. Song, **S. Lee**, and Y. W. Kim, "Pre-conceptual design of the main components for the NHDD program," Proceedings of the Korean Society of Mechanical Engineering (KSME) Annuals Spring & Fall Conference, Busan, Korea, pp. 48-51, May. 2007 (in Korean)
34. **S. Lee** and B. M. Kwak, "Design of flexural stage considering multiple constraints using smooth boundary topology optimization," Proceedings of the 7th World Congress on Structural and Multidisciplinary Optimization (WCSMO7), Seoul, Korea, May. 2007
35. C. H. Chung, **S. Lee**, B. M. Kwak, G. W. Kim, and J. H. Kim, "A delay line circuit layout for crosstalk minimization using genetic algorithm and experimental verification," Proceedings of the 7th World Congress on Structural and Multidisciplinary Optimization (WCSMO7), Seoul, Korea, May. 2007
36. D. H. Kim, **S. Lee**, B. M. Kwak, H. G. Kim, and D. A. Lowther, "Smooth boundary topology optimization for electrostatic problems through the combination of shape and topological design sensitivities," Proceedings of the 16th International Conference on the Computation of Electromagnetic Fields (COMPUMAG 2007), Aachen, Germany, Jun. 2007
37. K. N. Song, S. H. Lee, and **S. Lee**, "Impact Analysis and Test for the Spacer Grid Assembly of a Nuclear Fuel Assembly," Proceedings of the 6th International Symposium on Impact Engineering (ISIE2007), Daejeon, Korea, Sep. 2007
38. **S. Lee** and K. N. Song, "The evaluation of impact strength of IFM support grid and its experimental verification," Proceedings of the Korean Nuclear Society (KNS) Annuals Spring & Fall Conference, Yongpyeong, Korea, Oct. 2007 (in Korean)
39. K. N. Song and **S. Lee**, "Analysis of Impact Strength due to the Variation of Weld Length for the Nuclear Spacer Grid Assembly," Proceedings of the Korean Society of Mechanical Engineering (KSME) Annuals Spring & Fall Conference, Yongpyeong, Korea, pp. 17-20, Nov. 2007 (in Korean)
40. **S. Lee** and B. M. Kwak, "Design of a flexural stage using smooth boundary topology optimization," Proceedings of the 4th China-Japan-Korea Joint Symposium on Optimization of Structural and Mechanical Systems (CJK-OSM4), Kunming, China, Nov. 2006
41. C. H. Chung, **S. Lee**, B. M. Kwak, G. W. Kim, and J. H. Kim, "Delay line circuit design for crosstalk minimization using genetic algorithm," Proceedings of the 4th China-Japan-Korea Joint Symposium on Optimization of Structural and Mechanical Systems (CJK-OSM4), Kunming, China, Nov. 2006
42. **S. Lee**, I. Y. Kim, and B. M. Kwak, "Smooth boundary topology optimization and its application to hip prosthesis design," Proceedings of the Korean Society of Mechanical Engineering (KSME) Annuals Spring & Fall Conference, Yongpyeong, Korea, Nov. 2005 (in Korean)
43. **S. Lee** and B. M. Kwak, "Two-step structural optimization using Taguchi method and finite difference method," Proceedings of the 1st Asia-Pacific International Conference on Computational Methods in Engineering (ICOME), Sapporo, Japan, Nov. 2003
44. **S. Lee** and B. M. Kwak, "Automatic generation of orthogonal arrays for the Taguchi method and applications to structural optimal design," Proceedings of the 2nd China-Japan-Korea Joint Symposium on Optimization of Structural and Mechanical Systems (CJK-OSM2), Busan, Korea, Nov. 2002
45. **S. Lee**, S. B. Shin, J. S. Kim, and B. M. Kwak, "DS/Block – a CAD-based software system for

- simulation of lifting and turnover of ship block,” Proceedings of the Korean Society of Mechanical Engineering (KSME) Annuals Spring & Fall Conference, Jeju, Korea, 2001 (in Korean)
46. **S. Lee**, I. Y. Kim, and B. M. Kwak, “Continuum topology optimization,” Proceedings of the 10th AIAA/ISSMO Multidisciplinary Analysis and Optimization Conference (MAO), Albany, NY, Sep. 2004
47. **S. Lee**, S. B. Shin, and B. M. Kwak, “A CAD-based software for the simulation of lifting and turnover of ship block,” Proceedings of the Korean Society of Mechanical Engineering (KSME) Annuals Spring & Fall Conference, Ulsan, Korea, 2000 (in Korean)
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### INVITED SEMINAR

- Piezoelectric Energy Harvester and Sensor Network Design using Advanced Optimization Methodologies*, Jul. 2019. Intelligent Automation, Inc., Rockville, MD
- Topology optimization case studies: civil/mechanical engineering systems design*, Apr. 2018. Department of Civil Engineering, Johns Hopkins University, Baltimore, MD
- Design Optimization of Energy Harvesting System for Its Practical Use*, Jun. 2017. Korea Research Institute of Standards and Science, etc. , Daejeon, Korea
- Topology Optimization for Additive Manufacturing*, Jun. 2017. Korea Research Institute of Standards and Science, Ulsan, Korea
- A New Topology Design for Additively Manufacturable Structure Considering Printing Parameters*, Dec. 2016. National Institute of Standards and Technology, Gaithersburg, MD
- Design Issues on Electromagnetic Vibration Energy Harvesting for Self-Powering Structural Monitoring*, Dec. 2016. National Institute of Standards and Technology, Gaithersburg, MD
- Toward Practical Linear Electromagnetic Harvester in Military Backpack*, Sep. 2016. US Army CERDEC, Aberdeen, MD
- Design Optimization of Energy Harvesters and Smart Sensing System*, Jan. 2015. NAVSEA Warfare centers, Carderock, MD
- Design Methodologies of Vibration Energy Harvester for Sustainable Monitoring System*, May. 2014. Korea Atomic Energy Research Institute, Daejeon, Korea
- On Design Methodologies of Nonlinear Energy Harvester toward Broadband Energy Harvesting*, May. 2014. Korea Institute of Machinery and Materials, Daejeon, Korea
- Energy Harvesting Devices for Battery-less Operation of Small Electronics*, Mar. 2014. Department of Civil Engineering, Johns Hopkins University, Baltimore, MD
- Energy Harvesting Devices for Battery-less Operation of Small Electronics*, Department Seminar Series, Dec. 2013. University of Maryland School of Dentistry, Baltimore, MD
- Energy Harvesting Technology toward Self-sustainable Engineering System*, ME/ECE Research Seminars, Sep. 2011. Indiana University Purdue University Indianapolis, Indianapolis, IN
- Design Optimization Methodologies for Energy Harvesting Devices – Piezoelectric and Electromagnetic Perspectives*, Oct. 2012. Korea Institute of Machinery and Materials, Daejeon, Korea
- Design Optimization Methodologies for Energy Harvesting Devices – Towards Practical Rail System Application*, Oct. 2012. Korea Railroad Research Institute, Uiwang, Gyeonggi, Korea
- Design Energy Harvesting Devices for Battery-less Operation of Small Electronics*, Dec. 2013. University of Maryland School of Dentistry, Baltimore, MD

## PROFESSIONAL ACTIVITIES

### **Proposal Review Panel:**

National Science Foundation, 2013, 2015, 2018

### **ASME Technical Committee Member**

Adaptive Structures & Material Systems Group, 2015~

**Chair, ASME SMASIS Energy Harvesting Symposium, 2018~2021**

### **Consultation:**

“Parametric study on power of a tunable rotational energy harvester,” Innovation KR, Korea, 2014

### **Conference session chair:**

“Nonlinear and Broadband Harvesting I,” in ASME International Conference on Smart Materials, Adaptive Structures and Intelligent Systems (SMASIS), San Antonio, Texas, USA, Sep 2018

“Nonlinear and Broadband Harvesting II,” in ASME International Conference on Smart Materials, Adaptive Structures and Intelligent Systems (SMASIS), San Antonio, Texas, USA, Sep 2018

“Energy Harvesting - Design Optimization,” in SPIE Smart Structures/NDE 2018 Symposium, Denver, Colorado, USA, Mar 2018

“Energy Harvesting - Design Optimization,” in SPIE/SS-NDE 2018, Denver, Colorado, USA, Mar 2018

“Design of Interface Circuits,” in ASME SMASIS 2017, Snowbird, Utah, USA, Sep 2017

“Session 7-5 Elastic Wave Harvesting,” in ASME 2016 Conference on Smart Materials, Adaptive Structures and Intelligent Systems (SMASIS2015), Stowe, VT, USA, Sep 2016

“Nonlinear and Broadband Energy Harvesting II,” in ASME 2015 Conference on Smart Materials, Adaptive Structures and Intelligent Systems (SMASIS2015), Colorado Springs, CO, USA, Sep 2015

“Energy Harvesting and Scavenging: General Piezoelectrics,” in SPIE Smart Structures/NDE 2015 Symposium, San Diego, USA, Mar 2015

“Energy Harvesting 1,” in ASME International Design Engineering Technical Conferences (IDETC), Buffalo, USA, Aug 2014

“Optimization in Core Engineering Areas (I),” in 8th China-Japan-Korea Joint Symposium on Optimization on Structural and Mechanical Systems, Gyeongju, Korea, May 2014

“Optimization in Emerging Areas (1),” in 10th World Congress on Structural and Multidisciplinary Optimization, Orlando, USA, May 2013

### **Membership:**

AIAA (American Institute of Aeronautics and Astronautics)

ASME (American Society of Mechanical Engineers)

ISSMO (International Society for Structural and Multidisciplinary Optimization)

### **Student advisees (graduated):**

Sumin Seong (MS student): Design optimization of nonlinear vibration energy harvester (2013 – 2015)

Mahsan Bakhtiarinejad (MS student): Hybrid design optimization methodology for subsystem allocation and topology optimization (2013 – 2015)

Christopher Mullen (MS student): Design Optimization of an Electromagnetic Energy Harvester Backpack for Utilization of Human Walking Energy (2014 – 2016)

Richard Fan (MS student): Feasibility Study of an Implantable Piezoelectric Energy Harvester Utilizing Human Mandibular Deformation to Power an Implantable Biosystem (2014 – 2016)

Amin Toghi Eshghi (PhD student): Hybrid Reliability Analysis Methods and Its Applications to High Dimensional Reliability-Based Design Optimization (2015 – 2019)

**Journal Editor:**

Guest editor, Special Issue on “Energy Harvesting Systems for Powering Wireless Sensors,” Electronics (ISSN 2079-9292), MDPI, 2019 – 2020

**Peer Reviewer:**

Journal of Mechanical Design

Journal of intelligent Material Systems and Structures

Smart Materials and Structures

International Journal for Numerical Methods in Engineering

Structural and Multidisciplinary Optimization

Engineering Structures

Engineering Optimization

Optimization and Engineering

**SKILLS**

FEM: ANSYS(16 year experience), NASTRAN, ABAQUS, HyperMesh, LS-DYNA, FLUENT

CAD: Pro/ENGINEER, IDEAS, SolidWorks, CATIA, Autodesk Inventor, AutoCAD

Programming Languages: MATLAB, C/C++, FORTRAN, LabView for NI DAQ