

# Seokwon Cho

Mississippi State University  
501 Hardy Road, 321 Walker Hall, Drawer A, MS 39762, USA

<mailto:scho@msstate.edu>

M: +1-612-512-5520

## Executive Summary

- Status: Permanent resident of United States
- Combustion research scientist with 10+ years of experience in combustion experiments, 0D/1D chemical kinetics and heat transfer simulations, data analysis, with strong lab testing and troubleshooting skills
- Solid technical background in thermal sciences, thermodynamics, combustion, and heat transfer
- Highly motivated and collaborative with strong leadership qualities, enjoy an atmosphere of hands-on thriving in ambiguity with persistency
- 22 international publications, with 219 number of citations, Google scholar site: <https://bit.ly/3bpP3Da>

## Experience



**Sandia  
National  
Laboratories**

Applied Combustion Research II  
**Sandia National Laboratories**  
Livermore, CA, USA

Nov. 2020 – Present

### Postdoctoral Appointee

- Development and application of MEMS-based dynamic heat flux sensor, 1D heat transfer modeling and design/structure optimization
- Multi-dimensional (0-3D) modeling: fuel spray/engine simulations and numerical studies using chemical kinetics
- Development of new high-speed optical combustion diagnostics: CH<sub>2</sub>O extinction
- Combustion and fuel optimization study for catalyst-heating operation
- Medium-duty/off-road diesel engine experiment and data analysis
- Publications: 4 published, 4 under review, 5 in preparation



UNIVERSITY  
OF MINNESOTA  
**University of Minnesota**  
Minneapolis, MN, USA

Jul. 2019 - Oct. 2020

### Post-Doctoral Associate

- Cooperative Fuel Research engine testing bench setup and test, establishing in-house combustion analyzing system and data logger
- Computation modeling in multi-processing environment: laminar flame speed and ignition delay
- Developing 0D/1D simulation models for CFR engine coupled with OCM reactor
- Research mentoring, paper advising for multiple graduate students
- Publications: 1 published, 1 under review, 1 in preparation



**Seoul National University**  
Seoul, South Korea

Mar. 2012 - Jul. 2019

### Graduate Research Assistant / Postdoctoral Research Associate

- Single/multi-cylinder engine test (metal/optical)
- 1D simulation: DoE, model development
- 0D model development of a virtual knock sensor
- Design, fabrication and implementation of ion-probe flame detection device
- Engine test cell/facility management
- Research mentoring for graduate students
- Publications: 17 published, 1 in preparation

## Education

Mar. 2012 – Jun. 2018

**Ph.D.**, Seoul National University, Seoul, Korea  
Mechanical and Aerospace Engineering (GPA: 3.64/4.30)  
Dissertation: *Study on the Effect of Cylinder Wall Temperatures on Knock Characteristics in Spark-Ignited Engine*

Mar. 2006 – Feb. 2012

**B.S.**, Seoul National University, Seoul, Korea  
Mechanical and Aerospace Engineering (GPA: 3.43/4.30)

## Research interests

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- Fast-response heat flux sensor development, modeling, and application
- Optical and combustion/flow diagnostics
- Sustainability in various propulsion systems, low carbon intensity fuels, future mobility
- Multi-dimensional fuel spray modeling and chemical kinetics, 0D single/two-zone combustion analysis
- Auto-ignition modeling and experiment in propulsion and powertrain system, advanced combustion control
- 1D simulation: combustion profile matching, heat transfer estimation and model development

## Teaching and mentoring experience

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### University of Minnesota

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|-----------------------|--|
| May. 2020 - Aug. 2020 | • Lecturer (Job code: 97531): <i>Thermodynamics</i> - ME3331<br>25+ students, <i>Student Rating of Teaching</i> : 4.73/6, <i>ratemyprofessor</i> : 5/5 |
| Jul. 2019 - Oct. 2020 | • Research mentoring for three graduate students   |

### Seoul National University

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|-----------------------|--|
| Mar. 2012 – Aug. 2018 | • Technical advisor of Seoul National University (SNU) Society of Automotive Engineers (SAE) Baja team |
| Mar. 2013 - Feb. 2018 | • Thesis assistant for three SNU undergraduate students  |
| Spring, 2014          | • Teaching assistant, <i>heat transfer</i>   |

## Technical Skills

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Experiment and lab testing setup	Single/multi-cylinder engine experiment, optical/laser diagnostics
DAQ/control	LabVIEW, RTOS/FPGA, ETAS, Drivven, AVL Indi-series, Visio
Post-processing/programming	MATLAB, Python
Chemical kinetics	Cantera, CHEMKIN, Converge
1D simulation	GT-Power (analysis, optimization, DoE)
3D CAD	Solidworks, Pro/ENGINEER, CREO
3D simulation	ANSYS, RecurDyn, COMSOL, Converge
Report automation	DIAdem
Other computer skills	MS Office, OriginLab, Illustrator, Photoshop, Davinci resolve

## Service

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Paper reviewer	Applied Energy Energy SAE Technical Paper International Journal of Engine Research ASME Journal of Gas Turbines and Power ASME journal of Energy Resources Technology Oil & Gas Science and Technology Energies Sandia National Laboratories (internal)
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Government program reviewer	U.S. Department of Energy SBIR/STTR program reviewer (2021)
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## Patents

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1. Min, K., Song, C., **Cho, S.**, Lee, Y., Park, J., "METHOD FOR PREDICTING KNOCKING OCCURRENCE OF ENGINE", Apr. 2021, Korea, 10-2020-0046297.
2. Min, K., Song, C., **Cho, S.**, Lee, Y., Park, J., "METHOD FOR PREDICTING OCCURRENCE OF ENGINE KNOCKING", Jun. 2021, United States, 17/348, 168.

## Research projects

<b>Department of Energy</b> Sandia National Lab. Nov. 2020 – Present	Currently involved in four tasks: <ul style="list-style-type: none"><li>• Investigating fuel effects and injection optimization under cold-operating condition</li><li>• Developing optical, time-resolved transient measurement technique for formaldehyde using mid-IR laser</li><li>• Developing a MEMS-based heat flux sensor, including fabrication, testing, calibration and hardware modification</li><li>• Optimization of piston geometry to enhance thermal efficiency and reduce emission</li></ul>
<b>LDRD Program</b> Sandia National Lab. Nov. 2020 – Sep. 2021	Building Foundational Capabilities for Sustained Thermal Barrier Coating R&D for Internal Combustion Engine Applications <ul style="list-style-type: none"><li>• Modeling and development of MEMS-based heat flux sensor</li><li>• Engine 3D design and collaboration for developments of telemetry system and sensor</li></ul>
<b>Department of Energy</b> University of Minnesota Jul. 2019 – Oct. 2020	On-Demand Reactivity Enhancement to Enable Advanced Low Temperature Natural Gas Internal Combustion Engines (DE-FOA-0001813 Budget Period 2) <ul style="list-style-type: none"><li>• Project lead, created quarterly reports, developed presentations, and maintained budget</li><li>• Commissioned CFR engine and developed and performed experiments</li><li>• Developed and performed 0D/1D modeling for engine-reactor combined system</li></ul>
<b>Hyundai Motor Company</b> Seoul National University Apr. 2018 – Jul. 2019	Optimization of Combustion Chamber Design Parameters to Increase Thermal Efficiency in a Gasoline Engine <ul style="list-style-type: none"><li>• Lead researcher</li><li>• Set up single-cylinder engine, performed experiments and autoignition testing</li><li>• Collaborated with CFD researchers to analyze the intake port insulation effect</li></ul>
<b>Hyundai Motor Company</b> Seoul National University Aug. 2016 – Dec. 2018	Investigation on the Effect of Stroke-to-Bore Ratio of Gasoline Engines with Simulation and Experiment <ul style="list-style-type: none"><li>• Laboratory/engine testing system setup and experiment, autoignition testing</li><li>• 0D-based combustion analysis</li><li>• Perform 1D simulations: profile matching, 0D RGF model development, DoE</li><li>• Collaborated with CFD researchers to study effects on combustion speed</li></ul>
<b>Tenergy</b> Seoul National University Mar. 2015 – Sep. 2015	Development of Report Automation System for Vehicle Fuel Economy and Emission Test <ul style="list-style-type: none"><li>• Big data analysis on driving habit of Seoul intra-city buses</li><li>• Program development: NI DIAdem, VBS Script, MATLAB</li></ul>
<b>Hyundai Motor Company</b> Seoul National University Nov. 2013 – Oct. 2014	Analysis of EMS (?) data for Fuel Economy and Development of Reporting Automation System <ul style="list-style-type: none"><li>• EMS data analysis of vehicle cycle test</li><li>• Program development: NI DIAdem, VBS Script, MATLAB</li></ul>
<b>Ministry of Knowledge Economy of Korea</b> Seoul National University Nov. 2013 – Oct. 2014	Technology for Gasoline Engine Downsizing (Spray and flame visualization) – \$400,000 <ul style="list-style-type: none"><li>• Single cylinder optical engine test</li><li>• Spray visualization, measurement of spray impingement</li><li>• Fast FID, PM testing of split injection during cold start</li></ul>

## Scholarships

Mar. 2012 – Dec. 2017	Brain Korea 21+ Governmental Research scholarship – \$31,000
Mar. 2006 – Feb. 2012	Korean Student Aid Foundation – \$20,000

## Others

Other language skills	Chinese (CEFR C1), Korean (fluent)
Service	Two years in military (riot police) in South Korea

## Refereed journal publications

## Published

1. **Cho, S.**, Song, C., Lee, Y., Kim, N., Oh, S. and Min, K., “Prediction of Knock Propensity Using Stochastic Modeling in a Spark-Ignition Engine”, *International Journal of Engine Research*, 2022, <https://doi.org/10.1177/14680874221074993>.
2. Kim, N., Chung, J., Kim, J., **Cho, S.**, and Min, K., “Effect of Injection Parameters on Combustion and Emission Characteristics under Catalyst Heating Operation in a Direct-Injection Spark-Ignition Engine”, *Energy Conversion and Management*, 2022, <https://doi.org/10.1016/j.enconman.2021.115059>.
3. López-Pintor, D. and **Cho, S.**, “Effects of the stability of 2-methyl furan and 2, 5 dimethyl furan on the autoignition and combustion characteristics of a gasoline-like fuel”, *Fuel*, 2022, <https://doi.org/10.1016/j.fuel.2021.122990>.
4. Kim, J., Chung, J., Kim, N., **Cho, S.**, Lee, J., Oh, S., Song, C. and Min, K., “Numerical Investigation of Soot Emission Sources in a Direct-Injection Spark-Ignition Engine Based on Comprehensive Breakup Model Validation”, *International Journal of Engine Research*, 2021, <https://doi.org/10.1177/14680874211047524>.
5. **Cho, S.**, Song, C., Kim, N., Oh, S., Dong Han and Min, K., “Influence of the Wall Temperatures of the Combustion Chamber and Intake Ports on the Charge Temperature and Knock Characteristics in a Spark-ignited Engine”, *Applied Thermal Engineering*, 182, 116000, 2021, <https://doi.org/10.1016/j.applthermaleng.2020.116000>.
6. Kim, Y., Kim, M., Oh, S., Shin, W., **Cho, S.**, Song, HH., “A New Physics-based Modeling Approach for a 0D Turbulence Model to Reflect the Intake Port and Chamber Geometries and the Corresponding Flow Structures in High-Tumble Spark-Ignition Engines”, *Energies*, 12(10):1898, May. 2019, <https://doi.org/10.3390/en12101898>.
7. **Cho, S.**, Park, J., Song, C., Oh, S., Lee, S., Kim, M. and Min, K., “Prediction Modeling and Analysis of Knocking Combustion with an Improved 0D RGF Model and Supervised Deep Learning”, *Energies*, 12(5):844, Mar. 2019, <https://doi.org/10.3390/en12050844>.
8. Oh, S., **Cho, S.**, Seol, E., Song, C., Shin, W., Min, K. and Song, HH., “An Experimental Study on the Effect of Stroke-to-Bore Ratio of Atkinson DISI Engines with Variable Valve Timing”, *SAE Int. J. Engines*, 11(6), pp 1183-1193, 2018, <https://doi.org/10.4271/2018-01-1419>.
9. Lee, K., **Cho, S.**, Kim, N. and Min, K., “A study on combustion control and operating range expansion of gasoline HCCI”, *Energy*, Vol. 91, pp 1038-1048, Nov. 2015, <https://doi.org/10.1016/j.energy.2015.08.031>.
10. Kim, N., **Cho, S.** and Min, K., “A study on the combustion and emission characteristics of an SI engine under full load conditions with ethanol port injection and gasoline direct injection”, *Fuel*, Vol. 158, pp 725-732, Oct. 2015, <https://doi.org/10.1016/j.fuel.2015.06.025>.

## Under review

1. **Cho, S.**, Lee, H., Lin, Y., Singh, S., and Northrop, W., “Products of Catalytic Oxidative Coupling of Methane to Improve Thermal Efficiency in Natural Gas Engines”, *Energy Conversion and Management*.
2. **Cho, S.**, López-Pintor, D., and Goldsborough, S., “Chemical Kinetic Interactions and Sensitivity Analyses for 2-Ethylhexyl Nitrate-doped PRF91 using a Reduced Mechanism”, *Fuel*.
3. Wu, A., **Cho, S.**, López-Pintor, D., Busch, S., Perini, F., and Reitz, R., “Effects of a CFD-improved Dimple Stepped-lip Piston on Thermal Efficiency and Emissions in a Medium-duty Diesel Engine”, *International Journal of Engine Research*.
4. López-Pintor, D., Mehl, M., **Cho, S.**, and Dec, J., “A Methodology to Replicate LTGC Engine Conditions in a Single-zone Model and Validation of a Surrogate Fuel for an AKI 88.5 – E10 Research-grade Gasoline Versus Experimental Measurements”, *Energy & Fuels*.
5. **Cho, S.**, López-Pintor, D., “Understanding the Effects of Doping a Regular E10 Gasoline with EHN in an HCCI Engine: Experimental and Numerical Study”, *Fuel*.
6. **Cho, S.**, López-Pintor, D., Sofianopolos, A., and Mamalis, S., “A Skeletal Mechanism for Gasoline Surrogates: Development, Validation and CFD Application”, *Fuel*.

## In Preparation (tentatively to be submitted in fall 2022)

1. López-Pintor, D., **Cho, S.**, and Dec, J., “Understanding the performance of OI in LTGC engines from beyond MON to beyond RON”.
2. **Cho, S.\***, Busch, S., López-Pintor, D., and Wu, A., “Impact and sensitivity analysis of design parameters in MEMS-based fast-response heat flux sensor using 1D numerical simulation”.
3. **Cho, S.**, Wu, A., Busch, S., and López-Pintor, D., “Effect of Distillation Temperature of Fuel on Catalyst-Heating Operating in an Off-Road Diesel Engine”.
4. **Cho, S.**, Wu, A., Kim, N., Busch, S. and López-Pintor, D., “Fast-Response Measurement of Formaldehyde using Mid-IR Exhaust Runner Extinction Diagnostics”.
5. Lee, H., **Cho, S.\***, and Northrop, W., “Thermal Efficiency Enhancement using Integrated OCM Reactor in Natural Gas Engine”, *Energy and Fuels*.

6. Oh, S., **Cho, S.**, Shin, W., Song, C., Min, K., and Song, HH., “The Effects of Bore-to-Stroke Ratio on Thermal Efficiency in Spark-Ignited Engine”.

## Refereed conference publications

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1. **Cho, S.\***, Busch, S., Angela Wu, and López-Pintor, D., “Effect of Fuel Cetane Number on the Performance of Catalyst-Heating Operation in a Medium-duty Diesel Engine”, *SAE Technical Paper* 2022-01-0483, Apr. 2022, <https://doi.org/10.4271/2022-01-0483>.
2. Wu, A., Busch, S., Perini, F., **Cho, S.**, López-Pintor, D. and Reitz, R., “Numerical studies of a novel dimpled stepped-lip piston design on turbulent flow development in a medium-duty diesel engine”, *SAE Technical Paper* 2022-01-0400, Apr. 2022, <https://doi.org/10.4271/2022-01-0400>.
3. Busch, S., Wu, A. and **Cho, S.**, “Catalyst heating operation in a medium-duty diesel engine: operating strategy calibration, fuel reactivity, and fuel oxygen effects”, *SAE Technical paper* 2021-01-1182, Sep. 2021, <https://doi.org/10.4271/2021-01-1182>.
4. Park, J., Lee, S., **Cho, S.**, Shin, S., Kim, M., Song, C. and Min, K., “Improvement of Knock Onset Determination Based on Supervised Deep Learning Using Data Filtering”, *SAE Technical paper* 2021-01-0383, Apr. 2021, <https://doi.org/10.4271/2021-01-0383>.
5. **Cho, S.**, Song, C., Lee, Y., Park, J., Song, HH. and Min, K., “Development of Knock Prediction Model for On-board Control in a Spark-Ignited Engine”, *SIA 2019 Paris Powertrain & Electronics*, Port-Marly, France, Jun. 2019.
6. **Cho, S.**, Oh, S., Song, C., Shin, W., Song, S., Song, HH., Lee, B., Jung, D., Woo, SH. and Min, K., “Effects of Bore-to-Stroke Ratio on Efficiency and Knock Characteristics in a Single-cylinder GDI Engine”, *SAE Technical paper* 2019-01-1138, 2019, Apr. 2019, <https://doi.org/10.4271/2019-01-1138>.
7. Oh, S., **Cho, S.**, Shin, W., Min, K. and Song, HH., “Experimental Study on the Knock Phenomena in the Individual Cycle of Direct-Injected Spark-Ignition Engine with Various Stroke-to-Bore Ratios”, *Proceedings of the European Combustion Meeting*, Lisboa, Portugal, Apr. 2019
8. **Cho, S.**, Song, C., Oh, S. and Min, K., “An Experimental Study on the Knock Mitigation Effect of Coolant and Thermal Boundary Temperatures in Spark Ignited Engines”, *SAE Technical paper* 2018-01-0213, Apr. 2018, <https://doi.org/10.4271/2018-01-0213>.
9. Min, K., Song, C. and **Cho, S.**, “A Study on the Effect of Wall Temperature on Knock Phenomena using a Single Cylinder Spark-Ignited Engine”, *FISITA 2018*, Chennai, India, Oct. 2018.
10. **Cho, S.**, Song, C., Kim, M., Ha, K., Kim, B., Suh, I. and Min, K., “The Effect of Thermal Boundary Conditions on Knock Characteristics in a Single Cylinder Spark Ignited Engine”, *SIA Powertrain Conference 2017*, Versailles, France, Jun. 2017.
11. **Cho, S.**, Kim, N., Chung, J. and Min, K., “The Effect of Ethanol Injection Strategy on Knock Suppression of the Gasoline/Ethanol Dual Fuel Combustion in a Spark-Ignited Engine”, *SAE Technical paper* 2015-01-0764, Apr. 2015, <https://doi.org/10.4271/2015-01-0764>.
12. Kim, N., **Cho, S.**, Choi, H., Song, HH. and Min, K., “The Efficiency and Emission Characteristics of Dual Fuel Combustion Using Gasoline Direct Injection and Ethanol Port Injection in an SI Engine”, *SAE Technical paper* 2014-01-1208, Apr. 2014, <https://doi.org/10.4271/2014-01-1208>.

## Presentations

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1. **Cho, S.**, Wu, A., Busch, S., Lopez-Pintor, D., “Efforts to Reveal Unburned Hydrocarbon and Formaldehyde Formation in Diesel Catalyst-Heating Operation by High-Speed FID and Mid-IR Extinction Diagnostics”, *SAE Fuel and Lubricants Meeting*, Krakow, Poland, Sep. 2022. (*accepted*)
2. **Cho, S.**, Wu, A., Busch, S., Lopez-Pintor, D., “Efforts to Reveal Formaldehyde Formation in Catalyst-Heating Operation: Fuel CN Effect and Mid-IR Laser Diagnostics”, *Advanced Engine Combustion Meeting*, Online, Feb. 2022.
3. Wu, A., **Cho, S.**, Lopez-Pintor, D., Busch, S., “Engine Experiments Using a CFD-Improved Dimple Stepped-Lip Piston in a Diesel Engine”, *Advanced Engine Combustion Meeting*, Online, Feb. 2022.
4. Northrop, W., **Cho, S.**, Lee, H., Lin, Y., Singh, S., Steele, A., “Controlling NG Autoignition in Engines using C2 Molecules from Catalytic Oxidative Coupling of Methane”, *Combustion TCP*, IEA, Sep. 2021.
5. Busch, S., Wu, A., **Cho, S.**, “Study of Catalyst Heating Operation in Sandia's Medium-Duty Diesel Engine”, *Advanced Engine Combustion meeting*, Online, Feb. 2021.
6. Northrop, W., Lee, H., Lin, Y., **Cho, S.**, Singh, S., Steele, A., “Controlling NG Autoignition in Engines using C2 Molecules from Catalytic Oxidative Coupling of Methane”, *Natural Gas TLM*, IEA meeting, Aug. 2020.
7. Song, C., **Cho, S.**, Park, J., Lee, Y. and Min, K., “Development of Virtual Knock Sensor in Spark-Ignited Engines”,

AARC International Symposium, Seoul, Korea, Dec. 2018.

8. **Cho, S.**, Song, C. and Min, K., “Effect of Cylinder Wall Temperatures on Knock Phenomena in Spark-Ignited Engines”, Hyundai Research Fellow Technical Forum, Ui-wang, Korea, Jul. 2018.
9. **Cho, S.**, Song, C. and Min, K., “Effect of Thermal Boundary Conditions on the Knock Mitigation in SI Engines”, 10<sup>th</sup> Engine Researchers Forum, Dali, China, Jan. 2018.
10. **Cho, S.**, Song, C. and Min, K., “Effect of Thermal Boundary Conditions on Knock Mitigation in SI Engines”, AARC International Symposium, Seoul, Korea, Nov. 2017.
11. **Cho, S.**, Oh, H., Park, M., Bang, J., and Min, K., “Development of Report Automation System for Fuel Economy Analysis using DIAdem”, NI Days, Seoul, Korea, Apr. 2015.

## References

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### **Paul Miles, PhD**

*Manager*

Applied Combustion Research II  
Sandia National Laboratories

PO Box 969 MS9053  
7011 East Ave, Livermore, CA 94550

+1-925-294-1512

[pcmiles@sandia.gov](mailto:pcmiles@sandia.gov)

### **Stephen Busch, Dr.-Ing.**

*System Performance Engineer  
Former Technical Staff at Sandia*

Cummins

4601 E Wembley Ln, Columbus, IN 47201

+1-925-922-7881

[sbbusch@gmail.com](mailto:sbbusch@gmail.com)

### **Dario López-Pintor, PhD**

*Senior Member of the Technical Staff*

Applied Combustion Research II  
Sandia National Laboratories

PO Box 969 MS9053  
7011 East Ave, Livermore, CA 94550

+1-925-294-3577

[dlopezp@sandia.gov](mailto:dlopezp@sandia.gov)