SEUNG WHAN CHUNG

PhD Student ⋄ Theoretical and Applied Mechanics ⋄ University of Illinois at Urbana-Champaign
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EDUCATION

University of Illinois at Urbana-Champaign *January 2017 - Expected: May 2021*
Ph. D in Theoretical and Applied Mechanics (candidate) GPA: 4.0/4.0
University of Illinois at Urbana-Champaign *August 2014 - December 2016*
M. S in Theoretical and Applied Mechanics GPA: 3.88/4.0
Seoul National University *March 2008 - February 2014*
B. S. in Mechanical and Aerospace Engineering GPA: 3.96/4.3

RESEARCH

○ Multi-point penalty-based optimization for chaotic flow control

Graduate researcher *University of Illinois at Urbana-Champaign*
Advisor: Prof. Jonathan B. Freund December 2019 - Present

· Quantified and analyzed optimization performance degradation in chaotic dynamical systems.
· Developed multi-point penalty-based optimization framework for non-convex optimization of chaotic flows.
· Demonstrated the method in various chaotic flow control optimizations, from 1D Kuramoto–Sivashinsky equation to 3D turbulent Kolmogorov flow.
· In preparation for a publication.

○ Adjoint-based optimization for a supersonic jet noise

Graduate researcher *University of Illinois at Urbana-Champaign*
Advisor: Prof. Jonathan B. Freund May 2017 - December 2019

· Implemented a compressible Mach-1.3 jet simulation, using a Fortran-based Navier-Stokes solver with energy-stable high-order finite-difference discretization.
· Verified turbulence development of the jet
· Implemented Ffowcs-Williams-Hawkings (FWH) solver to validate sound radiation of the jet
· Performed the jet noise control optimization using 10^4 CPUs, and quantified optimization performance degradation in the chaotic turbulent jet.

○ Sensitivity algorithm for particle-in-cell (PIC) plasma kinetics

Graduate researcher *Center for Exascale Simulation of Plasma-Coupled Combustion*
Advisor: Prof. Jonathan B. Freund January 2015 - January 2017
Student intern *Sandia National Laboratory*
Mentor: Dr. Stephen D. Bond, Dr. Eric C. Cyr January 2017 - May 2017

· Formulated discrete, particle-exact sensitivity in PIC simulation, and demonstrated sensitivity degradation due to chaotic particle dynamics.
· Participated in a 4-month student internship at Sandia National Laboratory for collaboration.
· Developed new particle-pdf sensitivity method which avoids the chaotic effect of particle dynamics. Published a peer-reviewed journal paper.
· Demonstrated the sensitivity algorithm for the sensitivity of Debye shielding response and sheath edge formation.
· Developed a Fortran-based 2D finite-volume Vlasov solver for validation of the new sensitivity algorithm.

TEACHING

- **TAM 210/211: Statics** Spring 2020
  Teaching Assistant University of Illinois at Urbana-Champaign
  - Ranked as Excellent in the list of Spring 2020 semester.
  - Conducted discussion sessions (1 time/wk) for 27 students.
  - Prepared in-depth solution procedures.
  - Provided extended office hours: 6 hrs/wk

PUBLICATIONS

S. W. Chung & J. B. Freund, "A proper gradient-based optimization framework for optimal control of chaotic turbulent flows," *In preparation.*

S. W. Chung, S. D. Bond, E. C. Cyr, & J. B. Freund, "Regular sensitivity computation avoiding chaotic effects in particle-in-cell plasma methods," *Journal of Computational Physics*, **400** (2020).

PRESENTATIONS

S. W. Chung & J. B. Freund, "Multi-point augmented Lagrangian optimization for chaotic flows," *SIAM Conference on Computational Science and Engineering*, (2021).

S. W. Chung & J. B. Freund. "Multi-point augmented Lagrangian optimization for chaotic flows," *Bulletin of the American Physical Society*, **65** (2020).

S. W. Chung & J. B. Freund, "Adjoint-based analysis of controllability of turbulent jet noise," *Bulletin of the American Physical Society*, **64** (2019).

S. W. Chung, S. D. Bond, E. C. Cyr, & J. B. Freund, "Regular sensitivity computation avoiding chaotic effects in particle-in-cell plasma methods," *International Conference on Numerical Simulation of Plasmas*, (2019).

S. W. Chung, S. D. Bond, E. C. Cyr, & J. B. Freund, "Sensitivity analysis in particle-in-cell methods," *SIAM Conference on Computational Science and Engineering*, (2019).

S. W. Chung, R. Vishnampet, D. Bodony, & J. B. Freund, "Adjoint-based sensitivity of jet noise to near-nozzle forcing," *Bulletin of the American Physical Society*, **62** (2017).

RESEARCH TOOLS DEVELOPED

- **`PASS`: Particle Adjoint Sensitivity Sandbox**
  with J. B. Freund https://github.com/dreamer2368/PASS
  - A Fortran-based 1D Particle-in-Cell – Monte-Carlo-Collision code for plasma kinetics simulations.
  - Particle-exact/particle-pdf sensitivity solver

- **`magudi`: Dual-consistent, Discrete-exact Adjoint solver for Compressible Flows**
  with R. Vishnampet, J. B. Freund https://bitbucket.org/xpacc-dev/magudi/
  - Created verification cases to ensure discrete-exactness.
  - Developed a Python-based Bash/Flux-script generator for large-scale gradient-based optimization.
  - Incorporated multi-point penalty-based optimization framework for chaotic dynamical systems.

- **`adjoint playground`: Adjoint, penalty-based optimization for chaotic flow controls**
  with J. B. Freund *Available upon request*
  - A MATLAB-based penalty-based optimization framework for various chaotic dynamical systems.
  - Provides a discrete-exact adjoint gradient for semi-implicit Runge-Kutta 4th-order time integrator.

AWARDS/FELLOWSHIPS

Jeong-Song Fellowship 2014 - 2016
Jeong-Song Cultural Foundation, Korea $110,000

Honor Graduation Award 2014
Seoul National University Ranked 5 of 139 (summa cum laude)

Presidential Science Fellowship 2008 - 2014
M. B. Lee, the President of Republic of Korea $40,000

GRADUATE COURSES

Fluid Mechanics	**Computational Methods**	**Applied Mechanics**
Inviscid Flow	Computational Mechanics	Control System Theory & Design
Viscous Flow	Uncertainty Quantification	Solid Mechanics I
Instability and Transition	Asymptotic Method	Combustion Fundamentals
Turbulence	Mathematical Methods II	Non-Newtonian Fluid Mechanics & Rheology

SKILLS

Computer Languages	Fortran, MATLAB, Python
Parallel Programming	MPI
Scripting	Python, Bash, Flux
Compiling	Make, CMake
Documentation	LaTeX, Vi/Vim, Mendeley
Visualization and I/O	PLOT3D, Paraview
Presentation	Beamer, Keynote, Adobe Illustrator/Premiere