# Sho Wada

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## EDUCATION

**Stanford University**, Stanford, CA, USA, 650-725-1575
Ph.D. Mechanical Engineering,
August 2024 - Present

**Kyoto University**, Kyoto, Kyoto city, Japan, +81 75-753-7531
Master of Engineering, Mechanical Engineering
April, 2022 - March, 2024

**Kyoto University**, Kyoto, Kyoto city, Japan, +81 75-753-7531
Bachelor of Engineering, Mechanical Engineering
April, 2018 - March, 2022

## PUBLISHED PAPERS

**Pressure-equilibrium Semi-implicit solver for real fluids**
S. Wada, R. Kai, A. L. Pillai, T. Yamada, R. Kurose, Physics of Fluids, 2024 (In production)

**A new semi-implicit pressure-based solver considering real gas effect**
S. Wada, R. Kai, R. Kurose (2024). *Journal of Computational Physics*, 501, 112782

**LES study on the breakup mechanism of LOX core in LOX/ GH2 supercritical combustion**
S. Wada, R. Kai, R. Kurose (2023). *Proceedings of the Combustion Institute*, 39, 2737-2745

## RESEARCH

**Development of the Discontinuous Galerkin method employing the Regularized Interfacial Method**
S. Wada, B. Krisna, M. Ihme (2024-Present)
To achieve the higher order accuracy with the unstructured grid for numerical simulation of real fluids, the Discontinuous Galerkin method employing the Regularized Interfacial Method, which is the state-of-the-art numerical method for transcortical fluid is being developed.

**Development of the efficient and robust semi-implicit pressure-based solver for real fluid flows under rocket engine operating conditions**
S. Wada, R. Kai, R. Kurose (2022-2024)
A semi-implicit pressure-based solver for real fluids is developed to efficiently simulate the mixing and combustion processes in rocket engines. The compressible Navier Stokes equation is decomposed into terms propagating with the fluid velocity and ones propagating with the acoustic speed in terms of the characteristic speeds. By solving the former ones explicitly and the latter implicitly considering the real fluid effects, the stiffness of the compressible Navier Stokes equation is alleviated and the numerical simulation of real fluid flows is free from the restriction of the acoustic CFL number while it can solve the acoustic wave. With this approach, the computational cost is reduced by more than 80% compared with the traditional density-based explicit solvers. This semi-implicit algorithm for real fluids is coupled with the method to suppress the spurious pressure oscillation, and its robustness is enhanced. As a result, the computational cost is reduced by more than 92 % for a numerical simulation under a very severe condition where conventional numerical schemes diverge immediately. Each numerical approach was validated with the experimental results.

**Numerical simulation of the noise generation in real fluid flows under transcritical and supercritical conditions**
S. Wada, A. L. Pillai, T. Yamada, R. Kurose (2023-2024)
The noise generation mechanism of the cryogenic nitrogen jet is investigated. A hybrid CFD/CAA solver is used to analyze the noise. The CFD solver is the above-mentioned efficient numerical solver, and the formulation of the CAA equation is revisited and developed to consider the real fluid effects correctly. Currently, the jet noise generated by a jet under a transcritical condition is found to be much louder than the one generated by a jet under a supercritical condition. The Dynamic Mode Decomposition method is conducted to extract the coherent structure inherent to the transcritical jet.

**Investigation of the mechanism of the deflagration to detonation transition (DDT) in an unconfined system**
S. Wada, K. Iwata, R. Kurose (2023)
The DDT mechanism in an unconfined system is investigated using the density-based explicit solver. Specifically, the interaction of the flame and the pressure wave through the effect of preferential diffusion effects of hydrogen is analyzed.

**Investigation of the breakup mechanism of LOX core in LOX/ GH2 supercritical combustion**
S. Wada, R. Kai, R. Kurose (2022-2023)
The breakup of LOX core in LOX/GH2 supercritical combustion field which is considered as one of the triggering factors of the combustion instability is studied using the flamelet progress variable approach considering the real fluid effect. A numerical simulation of the inert case is also conducted to analyze the effect of chemical reactions on the LOX core breakup by comparing the results between the reactive and inert cases. It is found that the volume dilatation induced by chemical reactions plays an important role in breaking up the LOX core in the reactive case, while the simple shear force produced by the injection velocity difference of the propellant breaks up the LOX core.

## AWARD

**Yoshida Research Award**/ Sep 2022
Given to **one out of seventy** undergraduate students in the Department of Mechanical Engineering for an excellent bachelor's thesis

**DMG Mori Seiki Scholarship**/ April 2024- September 2024

**Research Fellowship for young scientists, DC1**/ Declined the offer.

## PRESENTATION

**An efficient numerical algorithm for solving multi-component real fluid flows in rocket engines**
**S. Wada**, R. Kai, A. L. Pillai, R. Kurose
19th International Conference on Numerical Combustion (oral), 7-10 May 2024, Kyoto, Japan

**Applicability of a semi-implicit pressure-based algorithm without spurious pressure oscillations to real fluid flows**
**S. Wada**, R. Kai, A. L. Pillai, R. Kurose
APS Division of Fluid Dynamics 76th Annual Meeting (oral), 19-21 Nov 2023, Washington, DC, United States

**Development of Non-spurious Pressure Oscillation semi implicit Pressure-based Scheme for real fluid flows**
**S. Wada**, R. Kai, R. Kurose
ASME-JSME-KSME Fluid Engineering Division (oral), 10-13 July 2023, Osaka, Japan

**A semi-implicit pressure-based solver considering the real gas effect**
**S. Wada**, R. Kai, R. Kurose
The 11th Asia Joint Conference on Propulsion and Power (oral), 15-18 March 2023, Kanazawa, Japan

**LES study on the breakup mechanism of LOX core in LOX/$GH_2$ supercritical combustion**
**S. Wada**, R. Kai, R. Kurose
39th International Symposium on Combustion (oral), 24-29 July 2022, Vancouver, Canada

**Numerical investigation of the indirect combustion noise from supercritical GO2/GH2 non-premixed flame**
T. Yamada, A. L. Pillai, **S. Wada**, R. Kurose
Japanese Fluid Mechanics Symposium, 25-27 Sep 2024, Sendai, Japan

**LES/flamelet/ANN of oxy-fuel combustion for a supercritical CO2 power cycle under 8.2-28.5 MPa conditions**
H. Kasuya, Y. Iwai, Y. Morinishi, T. Nishiie, R. Kai, **S. Wada**, R. Kurose
JSFM Annual Meeting 2023, 20-22 Sep 2023, Tokyo, Japan