Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Suppression of self-excited thermoacoustic oscillations using genetic programming[1] BO YIN, YU GUAN, STEPHANE REDONNET, Hong Kong University of Science and Technology, VIKRANT GUPTA, Southern University of Science and Technology, LARRY K.B. LI, Hong Kong University of Science and Technology — Genetic programming (GP) is a powerful tool for unsupervised data-driven discovery of closed-loop control laws. In fluid mechanics, it has been used for various purposes, such as to enhance mixing in a turbulent shear layer and to delay flow separation. This model-free control framework is well suited for such complex tasks as it exploits an evolutionary mechanism to propagate the genetics of high-performing control laws from one generation to the next. Here we combine automated experiments with GP to discover model-free control laws for the suppression of self-excited thermoacoustic oscillations in a Rijke tube. Using a GP-based controller linked to a single sensor (a microphone) and a single actuator (a loudspeaker), we rank the performance of all the control laws in a given generation based on a cost function that accounts for the pressure amplitude and the actuation effort. We use a tournament process to breed further generations of control laws, and then benchmark them against conventional periodic forcing optimized via open-loop mapping. We find that, with only minimal input from the user, this GP-based control framework can identify new feedback actuation mechanisms, providing improved control laws for the suppression of self-excited thermoacoustic oscillations.

[1]This work was funded by the Research Grants Council of Hong Kong (Grants 16235716, 16210418 and 16210419).

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Date submitted: 30 Jul 2020 Electronic form version 1.4