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Closed-loop control of thermoacoustic oscillations using genetic programming[1] ANIMESH KUMAR JHA, BO YIN, LARRY K.B. LI, Hong Kong University of Science and Technology — The use of genetic programming (GP) to discover model-free control laws for nonlinear flow systems has gained considerable traction recently, having been applied for the closed-loop control of recirculation zones behind backward-facing steps, flow separation over sharp edges and turbulent mixing layers. This unsupervised data-driven control strategy has been shown to outperform conventional open-loop forcing, by enabling successful individual control laws to spread their genetic traits from one generation to the next. In this experimental study, we use GP to discover model-free control laws for the suppression of self-excited thermoacoustic oscillations, which are detrimental to combustion systems. We evaluate every individual control law in a given generation on a real-time closed-loop control system equipped with a single sensor (a pressure transducer) and a single actuator (a loudspeaker). We rank the effectiveness of the control laws with a cost function and use a tournament process to breed subsequent generations of control laws. We then benchmark the performance of the final generation against that of open-loop forcing, providing improved control laws for the suppression of self-excited thermoacoustic oscillations.

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