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Passive control of thermoacoustic oscillations with adjoint methods JOSE AGUILAR, MATTHEW JUNIPER, University of Cambridge — Strict pollutant regulations are driving gas turbine manufacturers to develop devices that operate under lean premixed conditions, which produce less NOx but encourage thermoacoustic oscillations. These are a form of unstable combustion that arise due to the coupling between the acoustic field and the fluctuating heat release in a combustion chamber. In such devices, in which safety is paramount, thermoacoustic oscillations must be eliminated passively, rather than through feedback control. The ideal way to eliminate thermoacoustic oscillations is by subtly changing the shape of the device. To achieve this, one must calculate the sensitivity of each unstable thermoacoustic mode to every geometric parameter. This is prohibitively expensive with standard methods, but is relatively cheap with adjoint methods. In this study we first present low-order network models as a tool to model and study the thermoacoustic behaviour of combustion chambers. Then we compute the continuous adjoint equations and the sensitivities to relevant parameters. With this, we run an optimization routine that modifies the parameters in order to stabilize all the resonant modes of a laboratory combustor rig.

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