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Stability analysis of thermo-acoustic nonlinear eigenproblems in annular combustors. Part I. Sensitivity

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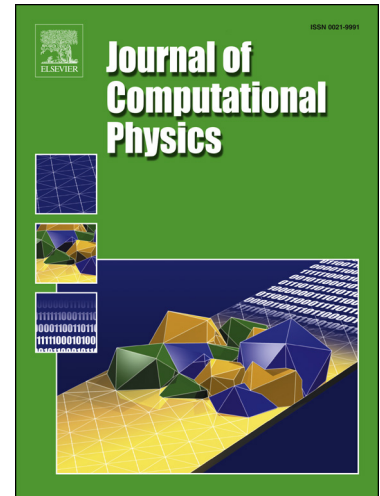
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1 Stability analysis of thermo-acoustic nonlinear
2 eigenproblems in annular combustors.
3 Part I. Sensitivity.

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8 **Abstract**

9 We present an adjoint-based method for the calculation of eigenvalue perturba-
10 tions in nonlinear, degenerate and non self-adjoint eigenproblems. This method
11 is applied to a thermo-acoustic annular combustor network, the stability of
12 which is governed by a nonlinear eigenproblem. We calculate the first- and
13 second-order sensitivities of the growth rate and frequency to geometric, flow
14 and flame parameters. Three different configurations are analysed. The bench-
15 mark sensitivities are obtained by finite difference, which involves solving the
16 nonlinear eigenproblem at least as many times as the number of parameters.
17 By solving only one adjoint eigenproblem, we obtain the sensitivities to any
18 thermo-acoustic parameter, which match the finite-difference solutions at much
19 lower computational cost.

20 *Keywords:* Thermo-acoustic stability, Sensitivity analysis, Annular
21 combustors, Adjoint methods

22 **Nomenclature**

23 **Abbreviations:**

24 AD Adjoint

25 FD Finite difference

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