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Optimal ignition placement using nonlinear adjoint looping UBAID QADRI, PETER SCHMID, Imperial College London, LUCA MAGRI, MATTHIAS IHME, Stanford University — Spark ignition of a turbulent mixture of fuel and oxidizer is a highly sensitive process. Traditionally, a large number of parametric studies are used to determine the effects of different factors on ignition and this can be quite tedious. In contrast, we treat ignition as an initial value problem and seek to find the initial condition that maximizes a given cost function. We use direct numerical simulation of the low Mach number equations with finite rate one-step chemistry, and of the corresponding adjoint equations, to study an axisymmetric jet diffusion flame. We find the $L-2$ norm of the temperature field integrated over a short time to be a suitable cost function. We find that the adjoint fields localize around the flame front, identifying the most sensitive region of the flow. The adjoint fields provide gradient information that we use as part of an optimization loop to converge to a local optimal ignition location. We find that the optimal locations correspond with the stoichiometric surface downstream of the jet inlet plane. The methods and results of this study can be easily applied to more complex flow geometries.

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