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Numerical Prediction of Nitrogen Oxide Emission Using Flamelet/Progress Variable Model MATTHIAS IHME, HEINZ PITSCH, Department of Mechanical Engineering, Stanford University — Unsteady flamelet models applied in large-eddy simulation of turbulent non- premixed combustion have been proven capable of predicting pollutants, such as CO and NO, with good accuracy. However, their application so far has been limited to simple geometries. The flamelet/progress variable (FPV) model developed for LES of non-premixed turbulent combustion in complex geometry is based on the steady flamelet approach. As a result of this assumption, slow physical and chemical processes such as radiation or the formation of NO_x cannot be described by this model. An extended FPV model has been developed, where, in addition to the solution of transport equations for the mixture fraction and progress variable, a scalar equation for the NO mass fraction is solved. The chemical source term appearing in this equation is modeled using the production term from a steady flamelet library. Since the NO consumption depends on the local NO mass fraction, additional closure assumptions are introduced for this term. This extended FPV model is applied in LES of Sandia flame D. Since the unsteady flamelet model yields good predictions for NO in this flame, the results are used to assess the importance of the individual parts of the filtered chemical source term for NO and to evaluate the accuracy of the modeling assumptions.

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