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Absar Ahmad

Detection of Changes in the Ventilation Conditions of a Fire and Implementation in an Inverse Fire Modelling Framework

A study is carried out to develop an Inverse Fire Modelling framework, which allows an estimation of fire growth along with changes in the ventilation conditions in a single room. In the first stage, the results of three forward models are compared in terms of smoke layer height and upper layer temperature. These three forward models are: (1) a Computational Fluid Dynamics Code (CFD), namely the Fire Dynamics Simulator (FDS), (2) a two zone model, the Consolidated Model of Fire Growth and Smoke Transport (CFAST), and (3) a simplified two zone model referred to as analytical model in this dissertation. This comparison reveals maximum deviations of 40% in both smoke layer height and temperature. In the second stage, the inverse fire model is developed using the same conservation correlations as in the analytical model. The upper layer temperature, T_u, and smoke layer height, h, obtained from CFAST are assimilated into the inverse model over a given period of time (called assimilation window) in order to estimate the fire growth together with any change in the ventilation conditions of the compartment. The results show that the HRR has a scatter of up to 40%, whereas the ventilation factor can be estimated with 50-150% deviations from the 'actual' value.