Boulder Fluid Dynamics Seminar Series

Tuesday, June 30, 2015
3:30pm-4:30pm (refreshments at 3:15pm)
Bechtel Collaboratory in the Discovery Learning Center (DLC)
University of Colorado at Boulder

The role of numerical models for exploration, explanation and hypotheses development in wildland fire behavior research

Chad Hoffman, *Colorado State University*

Advancement in computing power along with the growing threat of wildland fire in the past decades has resulted in new opportunities for the use of numerical models within wildland fire research. Models such as FIRETEC and the Wildland Urban Interface Fire Dynamics Simulator (WFDS) represent two examples of a new generation of numerical wildland fire behavior models. Such models attempt to represent the interactions among the dominant processes that determine wildland fire behavior such as convective and radiative heat transfer, aerodynamic drag and the buoyant response of the atmosphere to heat released by a fire. Although such models are not practical for operational fire management due to computing costs and data requirements they do provide opportunities to gain new perspectives into the fire and fuels management by allowing for new analysis and insights that would be impractical in most field settings. Numerical models can also be used to develop new hypotheses that can guide laboratory and field studies. Specific examples of the use of FIRETEC and WFDS into current fire and fuels management applications include 1) the interaction between ecosystem disturbances (e.g. bark beetles and fire), 2) the influence of vegetation heterogeneity and variability in fire behavior and spread, 3) understanding and improving the design and implementation of fuel and fire hazard mitigation strategies. Numerical studies such as those presented in the talk support new conceptual models for the dominant roles of multi-scale fluid dynamics in determining the nature and viability of fire spread. Although the results of these studies have provided new insights into the roles of upwind buoyancy-induced vorticity and crosswind fireline-intensity variations on heat transfer to unburned fuels, the influence of canopy structure on convective heating and cooling of canopy fuels and the impact of heterogeneous vegetation distribution/aggregation on wind penetration into canopies and crown fire behavior. There needs to be continued efforts to meet the challenges of validating the results from these numerical investigations with lab experiments and field observations, but, even so, they help progress wildfire science by suggesting relationships, interactions and phenomenology that should be considered in the context of the interpretation of observations, design of fire behavior experiments and development of new operational models.

The TrIGA Project: Higher Order Mesh Generation for Fluid-Structure Interaction

Luke Engvall, *University of Colorado, Boulder*

The TrIGA (Triangular IGA) project is a meshing project that aims to generate quality, geometrically exact, higher-order meshes for finite element analysis. There is a focus on developing meshes suitable for CFD, with a particular interest in fluid-structure interaction (FSI) problems. The talk will provide a brief background on Isogeometric Analysis (IGA), the parent field that inspired this work. Next, the meshing capabilities of TriGA will be presented for several interesting problems, as a well as demonstrations of mesh quality. Finally, the talk will discuss the distinct advantages of TrIGA for FSI problems, and some preliminary results will be presented.