Topological and Statistical Analytics of Turbulent Combustion

Application:

- Turbulent Combustion by Dr. Jackie Chen at SNL, and Dr. John Bell at LBNL

Goal: understanding turbulent combustion

- Combustion provides 85% of the US energy needs
- Low emission/temperature engines will operate at combustion regimes currently poorly understood
- Need new understanding of turbulence-chemistry to predict efficiency and pollutant emissions

Requirement: exploration of flexible Feature definition, analysis and tracking

- Develop robust feature definition
- Allow user to change parameters interactively and evaluate consequences on results
- Track features over time based on variable correspondence parameters
- Concurrent analysis of multiple fields restricted to the features of interest
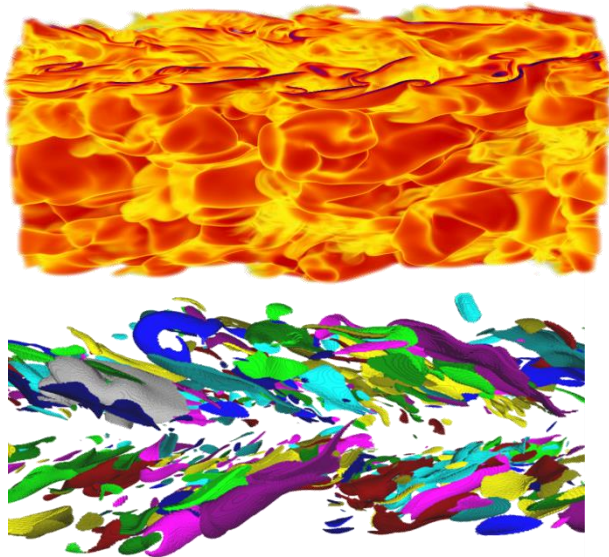
Challenges

- Accurate combustions simulation generate massive datasets that are hard to manage in postprocessing
- The data needs to be inspected by the user since selection parameters are not predetermined
- For each parameter selection
  - the user needs to get access the shape characterizations
  - understand the consequence on events like merging or splitting of features of time

(Upper left): Simulation of turbulent combustion
(Lower left): Segmentation of the data based on a particular feature definition