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Modeling of Radiative Heat Transfer for Energy Efficient Systems

In fire dynamics, radiative heat transfer is a crucial mechanism of energy transport and thus an important factor in flame propagation and fire spread. This applies across a wide range of scales, from small to very large, such as those encountered in building fires or wildfires. Radiative heat transfer is ubiquitous and also plays a significant role in the design and operation of energy-efficient systems. However, a detailed understanding of the spectral properties of participating media remains challenging. At interfaces and solid materials, directional and temperature-dependent behavior can further complicate the analysis.

With this poster, we present various numerical approaches to modeling radiative heat transfer—e.g., the Finite Volume Method (FVM) and Discontinuous Galerkin Finite Element Method (DGFEM)—in the context of fire dynamics. These methods can be transferred to other disciplines using the same tools but with varying levels of detail and computational effort. OpenFOAM is our primary simulation tool, as it enables the handling of highly complex geometries and can be combined with detailed species and temperature distributions. For specialized simulations, we also employ deal.II.

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