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A mesh-adaptive, Eulerian-Eulerian fluidized bed model with balanced finite element control volume methods applied to analyze particle size scaling laws

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The method developed here applies mesh optimization methods for fully unstructured triangular/tetrahedral to generate meshes optimized to represent particle laden flow physics in fluidized beds, using Eulerian-Eulerian multiphase modelling. It uses recently developed conservative, bounded, mesh-to-mesh interpolation methods based on Galerkin projections of information between the old and new meshes. The Eulerian-Eulerian model is based on a new finite element pair P1DG-P2, which has an elementwise quadratic, continuous finite element representation of pressure and elementwise linear velocities, discontinuous across element boundaries. This element pair is able to exactly represent important dynamic balances, for example, between linear buoyancy and hydrostatic pressure.

In this work we apply the model to analyze particle size scaling laws in an attempt to justify the use of fewer, larger Discrete Element Method (DEM) particles as a model of fine particles in fluidized beds.

Keywords: Computational methods, finite element method, fluidized beds, Discrete Element Method