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The Eulerian-Lagrangian Method of Fundamental Solutions for Simulating Heat and Flow Patterns in a Two-Roll Mill

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Summary

This article describes numerical investigations of the flow and heat patterns in a two-roll mill using the method of fundamental solutions (MFS). The MFS is a truly meshless method since it can get rid of the mesh generation and numerical quadrature. The numerical model is based on the operator-splitting formulation of the Navier-Stokes equations. The advection-diffusion equations are solved using the Eulerian-Lagrangian method of fundamental solutions (ELMFS), and the Poisson's equation can be solved by employing the method of particular solutions (MPS). Two numerical experiments are carried out, including the square cavity flow at the Reynolds number up to 1000 and two-roll mill flow generated by two inner cylinders rotating independently in fixed locations. The velocity profiles, streamline topologies and temperature contours are discussed for different type of the rotating velocities and Reynolds number. The robustness and flexibility of the proposed method are validated by results obtained from literature and the unstructured finite element method.

keywords: Meshless method; Method of fundamental solutions; Operator-splitting method; Navier-Stokes equations; Eulerian-Lagrangian method; Method of particular solutions

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