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A Velocity-Based Moving Mesh Virtual Element Method

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The use of polygonal discretization techniques for solving partial differential equations equations (PDEs) has been gaining substantial traction in recent years primarily due to the improved flexibility in representing complex geometries and the computational ease with which a polygonal mesh can be refined and agglomerated.

The literature is rich with works that generalise h- and p-adaptive algorithms to polygonal meshes but only recently has there been interest in developing polygonal moving mesh methods, sometimes referred to as “r-adaptivity”. Developing moving polygonal mesh methods raises additional challenges beyond standard finite element approaches on simplicial meshes. Such challenges include the construction of mappings between moving polygonal elements, the time-dependent nature of discrete spaces, and the robustness of the method.

In this talk, we present a Velocity-based Moving Mesh Virtual Element Method (extending the moving mesh framework of [1]) for non-linear diffusion free boundary problems. Here, polygonal meshes can be exploited to represent moving boundaries and interfaces with a minimal number of degrees of freedom and to produce efficient local mesh refinement when a change in mesh connectivity is required. Empirical results are presented for the method using the two-dimensional porous medium equation as a benchmark problem. Extensions of the method are then presented that exploit the mesh generality to tackle more geometrically complex problems, such as in contact problems.

REFERENCES

[1] MJ Baines, ME Hubbard and PK Jimack. Velocity-based moving mesh methods for non-linear partial differential equations. Communications in Computational Physics, 10(3):509-576, 2011.