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Numerical solution of the wave equation using the Partition of Unity Finite Element Method with explicit integration in time

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The method of using implicit time integration along with enriched finite element method has shown good potential as an approach to solve the wave equation in time[1]. Although robust and stable, the method inherently requires the solution of a system of linear equations every time step, which could be computationaly expensive especially if the domain of the problem at hand is very large. An alternative is to use an explicit integration in time.

In this paper we discuss the approach of explicit time stepping scheme applied to the scalar wave equation, synergising with the Partition of Unity Finite Element Method. The spacetime partial differential equation is discretized in space using the usual mechanics of the classical finite element method. The method is enriched in space with special functions that reduce the total degrees of freedom, required as compared to the classical finite element method, to capture the wave on the spatial grid while maintaining good accuracy. The differential equation in time is then tackled as a difference equation in time using widely available approaches such as the forward Euler scheme. The method is tested and validated through comparisons to analyse the utility of the approach against well-posed problems.

REFERENCES

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