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Fast mass lumped multiscale wave propagation modelling

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We investigate the use of a mass lumped fully explicit time stepping scheme for the discretisation of the wave equation with underlying material parameters that vary at arbitrarily fine scales. To avoid a global resolution of these fine spatial scales, we employ the multiscale technique known as Localized Orthogonal Decomposition for the spatial discretisation. The approach is combined with the leapfrog scheme for the discretisation in time. To speed up the method and to make it fully explicit, a special mass lumping approach is introduced that relies on an appropriate interpolation operator. This operator is also employed in the construction of the Localized Orthogonal Decomposition and is a key feature of the approach. We present rigorous convergence results that are independent of the scales at which the material parameters vary. We also illustrate the performance of the mass lumped method with numerical experiments.

REFERENCES

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