Optimal spectral element method for elastic wave computation

*Kei Hasegawa[1], Nobuaki Fuji[2], Kensuke Konishi[3]

1. Earthquake Research Institute, University of Tokyo, 2. Institut de Physique du Globe de Paris, 3. Institute of Earth Sciences, Academia Sinica

We introduce new numerical integration operators which compose the mass and stiffness matrices of a modified spectral element method for simulation of elastic wave propagation. While these operators use the same quadrature nodes as does the original spectral element method, they are designed in order that their lower-order contributions to the numerical dispersion error cancel each other. As a result, the modified spectral element method yields two extra-orders of accuracy, and is comparable to the original method of one order higher. The theoretical results are confirmed by numerical dispersion analysis and examples of computation of waveforms using our operators. Replacing the ordinary operators by those proposed in this study could be a non-expensive solution to improve the accuracy.

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