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Generalized frames for computing differential operators

In geophysical applications implementing numerical wavefield propagation, it has proven useful to decompose a complex geological medium into small local regions of nearly constant velocity, and propagate pieces of the wavefield through each region separately. The total wavefield is then obtained by reassembling all the pieces.

This decomposition/reassembling procedure can be described mathematically as a windowing procedure which is a specific implementation of generalized frames. By applying frame theory, we show that a collection of local wavefield propagators, combined via a suitable partition of unity, remains a stable propagator. This is a highly desirable property in numerical simulations and key to accurate solutions. These results apply more generally to combinations of linear operators that are useful for many nonstationary filtering operations.