High-Order Explicit Local Time-Stepping Methods For Wave Propagation

In the presence of complex geometry, adaptivity and mesh refinement are certainly key
for the efficient numerical simulation of wave phenomena. Locally refined
meshes, however, impose severe stability constraints on any explicit time-marching
scheme, where the maximal time-step allowed by the CFL condition is dictated by the
smallest elements in the mesh. When mesh refinement is restricted to a small subregion,
the use of implicit methods, or a very small time-step in the entire computational
domain, are very high a price to pay.
Explicit local time-stepping schemes (LTS) overcome the bottleneck due to a few small
elements by using smaller time-steps precisely where the smallest elements in the
mesh are located. When combined with a finite element discretization in space
with an essentially diagonal mass matrix, the resulting time-marching schemes
are fully explicit and thus inherently parallel.