Source Signal Recovery in Short-Duration Large-Domain Wave Propagation

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Abstract: In the area of short-duration large-domain acoustic and seismic signature propagation, highly accurate Reduced-Order Models (ROMs) represent an enabling technology. Such models are derived from a single High Performance Computing (HPC) simulation, and can be used to predict the dynamic responses to different source signals at the same location without having to perform the HPC simulation. It has been demonstrated that significant savings in computational resources and time can be achieved by this strategy, reducing what takes days on a HPC supercomputer to minutes on a laptop. Current research efforts are being made to extend the use of ROMs beyond output prediction. These efforts include the problems of source signal recovery and source localization. By taking advantage of the knowledge of the dynamics of the environment represented by these reduced-order models, it is possible to address the source signal recovery and localization problems in a highly complex multi-path environment with non-line-of-sight sensors.

In this paper, two time-domain techniques for source signal recovery are considered. The first uses a non-causal dynamic state-space inverse model. The second uses a static inverse model which relates the entire input signal time-history to the entire measured output signal time history. Due to the short-duration nature of the problem, it is found that the static inverse model is quite effective. Application of these two techniques on a HPC acoustic propagation model of the Cold Regions Research and Engineering Laboratory (CRREL) campus in Hanover, New Hampshire, USA is presented.

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