„Optimization strategy for development of new numerical models”

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Abstract

Accurate numerical solution of dynamic transient problems suffers from significant computational complexity and time. Choice of a particular technique for elastic wave propagation simulation is a key point as it relates to specific differences when compared to exact solutions. In particular, solution accuracy is influenced by grid type, discretization parameters and others, and – consequently – the quality of numerical respense is expected to deteriorate in comaprison to analytical solution.

In the presented work a novel optimization-based approach to developing new numerical models is presented. First, existing local computational approaches are described and analyzed in the context of their numerical spectral properties. In particular, numerical artifacts present in discrete models of continuous systems are discussed. Subsequently, an optimization strategy for the design of numerical models is presented. The optimization problem considers spectral properties errors between the exact and numerical solutions and modifies the structure of the underlying model. The minimization process is carried out through hybrid optimization techniques, mainly non-gradient Genetic Algorithms and gradient-based methods. As a result of the optimization process, compensation of discretization effects in given a frequency/wavenumber range is performed, including mesh-induced anisotropy.

Keywords: **Optimisation, Numerical modeling**