Adaptive Wavelet BEM

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In this talk, we will consider the adaptive wavelet boundary element method for the solution of boundary integral equations in three dimensions. Partial differential equations are frequently encountered in science and engineering, some of which can be formulated as boundary integral equations. This method, on one hand, allows us to reduce the dimensionality of the problem (3d to 2d), at the same time it is a possibility to deal with the infinite expansion of the domain, in case we consider an exterior problem.

For a domain with small geometrical features, or one containing corners and edges, we require a strong refinement in certain small parts of the geometry. In such cases, uniform refinement may not be an option any more (e.g. huge systems), making it necessary to have an adaptive approach at hand.

Even though the dimensionality of the underlying problem is already reduced drastically by working only on the boundary and using adaptivity, the involved matrix still is densely populated. Methods like panel clustering, hierarchical matrices or the adaptive cross approximation allow to reduce the complexity to log-linear or even linear cost. We will use wavelet compression which results in linear cost.

We will present an algorithm for the adaptive solution of boundary integral equations. In particular, we will elaborate on the efficient implementation of this algorithm. Finally, we will give various numerical examples involving the Laplace and the Helmholtz equation on different geometries.

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