Abstract. The accurate and efficient treatment of wave propagation phenomena is still a challenging problem. A prototypical equation is the Helmholtz equation at high wavenumbers. For this equation, Babuška & Sauter showed in 2000 in their seminal SIAM Review paper that standard discretizations must fail in the sense that the ratio of true error and best approximation error has to grow with the frequency. This has spurred the development of alternative, non-standard discretization techniques. This workshop focused on evaluating and comparing these different approaches also with a view to their applicability to more general wave propagation problems.


Introduction by the Organisers

The non-standard methods that could overcome the limitations of standard finite difference or finite element methods in the high-frequency regime include

- high order methods;
- Galerkin methods with special ansatz functions (e.g. plane waves);
- Petrov-Galerkin methods with wave-dependent test functions;
- boundary elements with a suitable compression of the integral operator.

Representatives of these methods were discussed at the workshop. In the time-harmonic setting, several talks covered questions of stability, both on the continuous level and of numerical schemes, with the particular emphasis of making the wavenumber-dependence explicit. The topic of \textit{a posteriori} error estimating and,
more generally, adaptivity for this problem class was addressed in several contributions. The iterative solution of the large systems of equations for Helmholtz and Maxwell systems is particularly delicate and therefore the topic of two talks. Since the underlying physical problem is often posed in unbounded domains, several presentations were devoted to questions of coupling different discretizations, to boundary element methods, and to “infinite elements”. Also, recent progress on some time-domain formulations such as convolution quadrature techniques was presented.

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Mini-Workshop: Efficient and Robust Approximation of the Helmholtz Equation

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