Austrian Numerical Analysis Day 2026

Global-function representations for wave scattering, device optimization and long-range propagation

Oscar P. Bruno[1]

[1] Caltech, California, US

Novel trends in the fields of numerical analysis and computational science seek to reap benefits from use of suitably accelerated representations of physical quantities by global functions–such as Green functions, Fourier and Chebyshev expansions, and Fourier transforms–in the contexts of applications concerning prediction, optimization, and design in geometrically realistic and spatio-temporally challenging scientific and engineering contexts. In this talk we consider various mathematical underpinnings inherent in the use of such methodologies in the intended contexts, and we illustrate these methods with variety of applications–including optimization and design of optical devices, time-domain evolution via Fourier transform of frequency-domain solutions, and the evaluation of long-range wave propagation through inhomogeneous media on the basis of the WKB approximation—including accurate simulation of fields across caustics for propagation problems up to millions of wavelengths in size.