

Evgeny Popov (1956) has obtained his PhD (1988) and ScD (1991) for the works on anomalies of diffraction gratings in the Institute of Solid State Physics (Bulgarian Academy of Sciences, Sofia), where he worked as a researcher, assistant and full professor till 2000. Since then he is a full professor in Aix-Marseille University, Marseille, France, teaching physics and mathematical methods of physics at undergraduate and graduate level. His research in the Institute Fresnel covers different topics of electromagnetic optics, scientific optical instrumentation, diffraction modelling using spectral methods such as Fourier modal method, differential and surface integral methods, coordinate transformation, and modal method. Evgeny Popov is a senior member of Institut Universitaire de France and Fellow of Optical Society of America.

### **Abstract**

A short review of several different electromagnetic spectral methods for modelling light diffraction by single or periodically arranged dielectric or metallic objects is proposed in view of studying systems having extreme optogeometrical parameters. The first example represents a three-segment 1D diffraction grating with length of several hundred wavelength, used as a narrow-band optical filter. The second study covers the plasmonic properties of metallic cones on that presents a giant (10 000 fold) enhancement of the field intensity, compared to the incident field intensity. The third example consists of a 1D echelette metallic grating made of negative-permittivity materials having simple- or hyper-singularity.