Schwarz's method and its applications to effective properties of dispersed composites

Vladimir Mityushev

The study of structurally disordered dispersed patterns and the hidden relationships between the geometric random characteristics of composites and their physical properties is a common focus in various branches of mechanics, mathematics, and physics. Our objective is to address the challenge of providing a constructive quantitative description of the chaos/regularity, e.g., dislocations, exhibited by composites. The mathematical results are based on the generalized alternating method of Schwarz and the Riemann-Hilbert problem for a multiply connected domain.

The current state of the art of the theory of composites is outlined. We discuss the notions of *model* and *empirical method* used in the framework of material sciences, highlighting the discrepancies when various engineering approaches overlook asymptotic precision and conditionally convergent series.

We propose the computationally effective method of structural sums coinciding with the lattice sums for regular composites. In particular, the results yield new high-order analytical exact and asymptotic justified formulas for the effective conductivity and elasticity tensors of dispersed composites with isotropic phases. We specifically investigate the macroscopic properties of dispersed regular and random composites with a qualitative analysis of the degree of randomness, anisotropy, and clustering.

Vladimir Mityushev, Cracow University of Technology, Kraków, Poland
e-mail : wladimir.mitiuszew@pk.edu.pl