The influence of the effective number degrees of freedom on the effective transfer coefficient in a heterogeneous medium, taking into account its geometric and topological properties

Mishin A.V.[1,2,@]

[1] Novosibirsk State University, Pirogova Street 2, Novosibirsk, 630090, None
[2] Khristianovich Institute of Theoretical and Applied Mechanics of the Siberian Branch of the Russian Academy of Sciences, Institutskaya 4/1, Novosibirsk, 630090, Russia

[@] alekseymishin1994@gmail.com

This work presents operations for homogenizing a stationary heat conduction equation with a Fourier-type equation of state. The heterogeneous medium is two-phase and occupies a bounded region. The method of conditional moments [1] and the generalized derivative formalism [2] are used, taking into account the configuration of the internal boundaries of the heterogeneous medium. The mechanism for the appearance of characteristic phase sizes in the effective coefficient is analyzed: the ratio of the characteristic phase sizes and the ratio of the characteristic phase size to the size of the heterogeneous medium region under consideration (the averaging size), which is a consequence of using the generalized derivative formalism and considering a bounded medium. The reason why the geometric characteristics of a heterogeneous medium influence its topological properties is analyzed, leading to the appearance of an effective number of degrees of freedom during the propagation of the field under study. The effective coefficient is obtained for a space of arbitrary dimension. This approach is focused on describing heterogeneous media with a hierarchical structure, as well as the formation of defects and cracks.

[1] Khoroshun L P 2000 *Applied Mechanics* **30**(10) 30–62
[2] Mishin A V 2023 *Journal of Applied and Industrial Mathematics* **26**