Секция «Вычислительная математика, математическое моделирование и численные методы»

Adaptive Wavelet-Based Simulation of Multiphase and Multicomponent Resin Flow

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One of the principal obstacles in liquid composite molding is the formation of porosity which strongly affects the physical and mechanical properties of the material. Therefore, it is essential to maximally decrease the number of dry spots and squeeze out entrapped bubbles before solidification. Modeling and simulation of resin flow require substantial computational resources of current commercial and research computational fluid dynamics tools because of the presence of a vast range of physical scales that need to be resolved. Our current effort is focused on the development of a computational technology for predictive modeling and simulation of multi-scale resin flow through fiber reinforced material.

The molding process was first considered at the micro-level (within tows, see Figure below) by conducting a direct numerical simulation of Navier—Stokes equations for miscible multiphase multicomponent resin flow with surface tension [1]. At this stage, the geometry of each individual fiber is resolved. A parallel adaptive wavelet-based methodology [2] is chosen due to its ability to identify dynamically localized flow structures and to construct computationally efficient adaptive meshes on the fly. The results from the direct simulations will be used to formulate a meso-model of Brinkman type for the flow within the tows. Subsequently, this model will be coupled with Stokes simulations for the flow between tows.

References

1) Schmidmayer K., Petitpas F., Daniel E., Favrie N., Gavrilyuk S. A model and numerical method for compressible flows with capillary effects // Journal of Computational Physics 334, 2017, P. 468–496
2) Nejadmalayeri A., Vasilyev O., Vezolainen A., Brown-Dymkoski E. Parallel adaptive wavelet collocation method for PDEs", Journal of Computational Physics 298, 2015, P. 237–253
3) Park C., Lebel A., Saouab A., Bréard J., Lee W. Modeling and simulation of voids and saturation in liquid composite molding processes, Composites: Part A 42, 2011, P. 658–668

Illustrations

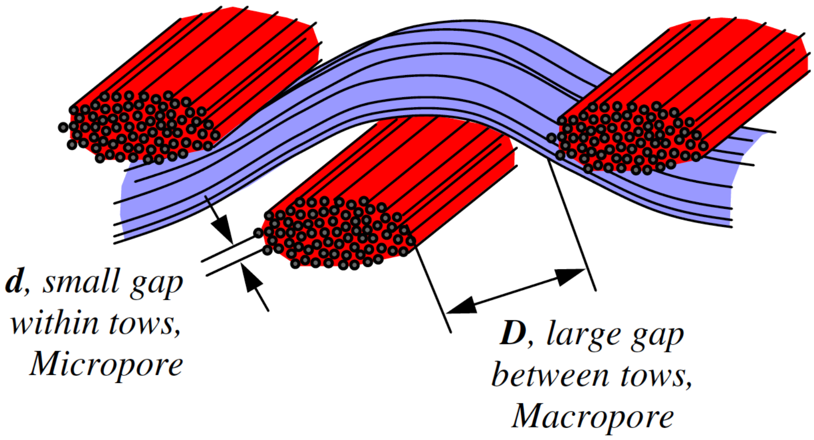

Рис. 1. A typical structure that is investigated in this work: textile reinforcement structure with two widely different length scales [3].