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Learning mappings from iced airfoils to aerodynamic coefficients using a deep operator networks

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This study abstracted the prediction of the aerodynamic coefficients of an iced airfoil as a mapping from the iced airfoil space to the aerodynamic coefficient space. Thus, a deep network called Airfoils2AeroNet that can learn this mapping is established based on a deep operator network (DeepONet). The deep network consists of a trunk network for encoding the iced airfoil images and a branch network for encoding the aerodynamic coefficient functions input. The branch network consists of deep convolutional neural networks (CNNs), and the trunk network consists of fully connected neural networks (FNNs). Then, the network is trained and tested based on iced airfoils based on NACA0012. Comparing the prediction results of Airfoils2AeroNet with those of the conventional direct CNN network, the network proposed in this paper has a strong advantage for generalization. Unlike the traditional CNN network, which can only predict the aerodynamic coefficients at fixed flow conditions consistent with the training data, the network can flexibly predict the aerodynamic coefficients at different flow conditions. Finally, the influence of the structure of the branch network and trunk network on the prediction results was analyzed.