Prediction of hydrodynamic instability in the curved ducts by means of HPM and ANNs

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Abstract

Curved ducts with non-circular cross-sectional geometry have significant applications in different industries. Hydrodynamic stability in these curved ducts is an interesting issue in field of fluid mechanics. In the present study, the linear hydrodynamics stability of fluid flow in the curved rectangular duct is investigated semi-analytically by Homotopy perturbation method (HPM). Then, for the first time, the hydrodynamic stability in these ducts is estimated via using artificial neural networks (ANNs). To this accomplishment, critical Dean number (Dnc) is estimated under various aspect ratios and curvature ratios. Based on the semi-analytical results, the Dnc is increased by curvature ratio enhancement. In addition, irregular variation on trend of Dnc is found by an enhancement in the aspect ratio. Moreover, maxima of mean square error and minima of correlation coefficient for intended ANN are obtained 0.00144 and 0.98621, respectively. Finally, predictive equation is suggested to estimate of Dnc using weights and bias of designed ANN.

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