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USING MACHINE LEARNING TO PREDICT THE CRITICAL REYNOLDS NUMBER OF A TANDEM CYCLINDER SYSTEM

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Using Machine Learning to Predict the Critical Reynolds Number of a Tandem Cylinder System

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ABSTRACT

Fluid flow past two cylinders placed next to each other (tandem configuration) is common in engineering applications. We utilize machine learning techniques coupled with computational fluid dynamics simulation to predict the critical Reynolds number of a tandem configuration. First, we compute the flow behavior using Gerris. We find that for certain special choices of cylinder separation to diameter ratio the flow evolves from laminar to oscillatory (turbulent) behavior at a specific critical Reynolds number. While it is possible to extract the pressure data to analyze the transition, a computational bottleneck is the sheer volume of the generated information. In our work, we have utilized singular value decomposition (SVD) and principal component analysis (PCA) to identify the critical Reynolds number. These techniques allowed us to remove irrelevant simulation information by reducing the data matrix dimension. Based on our calculations, we show that it is possible to reconstruct the pressure around the cylinder using a minimal amount of data to predict the correct critical number.

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