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Identifying Flow Physics in Convolutional Layers[1] ASHLEY SCILLITOE, The Alan Turing Institute, PRANAY SESHADRI, Imperial College London — In many industrial design processes computational fluid dynamics (CFD) simulations play a key role. However, the simulations are often computationally intensive and time-consuming. Data-driven methods offer the possibility of replacing expensive computational simulations with cheaper approximations. Recently, convolutional neural networks (CNN's) have seen increasing attention for this purpose. They offer accurate and fast data-driven flowfield predictions, allowing for near-immediate feedback for real-time design iterations. Unlike fully connected neural networks, which require large amounts of training data, CNN's have been shown to offer relatively accurate flowfield predictions even with only a small amount of training data. Despite this success, exactly how CNN's are able to provide such accurate results is not well understood, and efforts at interpreting their predictions have been limited. In the present work, we explore a CNN's flowfield predictions using state-of-the-art CNN interpretation techniques. Additionally, we examine parallels between CNN's and another recently proposed method for flowfield prediction, embedded ridge functions (ERF's). By identifying low dimensional structures in the flowfield, ERF's can provide important physical insights into the flow.

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