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Image Realization of Fluid Flow Distributions Using Convolutional Neural Networks

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Computational fluid dynamics is used in various fields such as heat-fluid related systems. However, if the analytical model becomes complicated, the element generation becomes difficult and the analysis time increases exponentially. In this study, we applied the simple model to the method of complementing the CFD analysis using convolution neural networks (CNN). CNN is a kind of deep neural network (DNN), which is composed of one or several convolution layer, pooling layer, fully connected layer. It is trained through the backpropagation algorithm and is mainly used for image recognition. The color information of the velocity distribution image of the flow field obtained by changing the inlet velocity for the NACA0012 airfoil using CFD was learned through CNN. When the desired inlet velocity is input using the learned CNN, the velocity distribution is predicted and compared with the results of CFD analysis. As a result, CFD and CNN showed an average agreement rate of 97%.

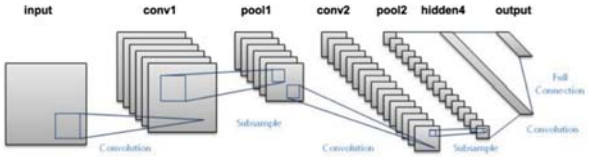
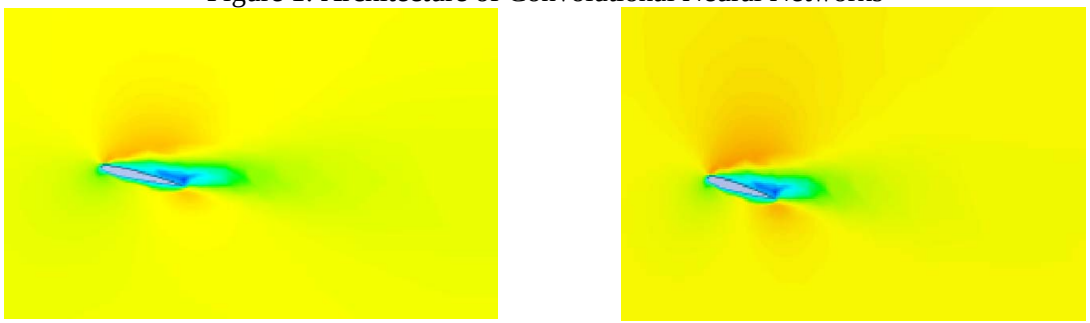


Figure 1: Architecture of Convolutional Neural Networks



(a) Velocity contour of acutal CFD **(b)** Velocity contour of CNN

Figure 2: Comparison between actural CFD and CNN prediction

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