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Predicting the 2-dimensional airfoil by using machine learning methods

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Abstract. In this paper, we develop models to design the airfoil using Multilayer Feed-forward Artificial Neural Network (MFANN) and Support Vector Regression model (SVR). The aerodynamic coefficients corresponding to series of airfoil are stored in a database along with the airfoil coordinates. A neural network is created with aerodynamic coefficient as input to produce the airfoil coordinates as output. The performance of the models have been evaluated. The results show that the SVR model yields the lowest prediction error.

Keywords: support vector regression model; neural networks; airfoil design; inverse design; backpropagation

1. Introduction

The aim of this paper is to generate geometry for airfoil with minimal error. Hence, we are supposed to enhance design method which will converge fast and have minimal error. There are many techniques in use, for example, hodo-graph methods for two-dimensional flows, (Garabedian 1971). The inverse design of backpropagation takes long time to converge. Hertz (1991) focused on better function and suitable learning rate and momentum in backpropagation algorithm. To design fast algorithm, Abid *et al.* (2001) proposed a new algorithm by minimizing sum of squares of linear and nonlinear errors for all output. Jeong *et al.* (2001) proposed learning algorithm based on first and second order derivatives of neural activation at hidden layers. Han *et al.* proposed modified constrained learning algorithms—First new Learning Algorithm and Second new Learning Algorithm to obtain faster convergence rate. The notable differences of the accelerated modified LM method are that the line search for the approximate LM step, Jinyan Fan (2014).

One of important things is when designing a particular neural network is to calculate proper weight for neural activities. The weight values are obtained from the training process of neural

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Sejnowski, T. and Rosenberg, C. (1987), "Parallel networks that learn to pronounce English text", *Complex Syst.*, **1**, 143-168.
Dutta, S., Samui, P. and Kim, D. (2018), "Comparison of machine learning techniques to predict compressive strength of concrete", *Comput. Concrete*, **21**(4), 463-470. https://doi.org/10.12989/cac.2018.21.4.463.
Zayid, E.I.M. and Akay, M.F. (2012), "Predicting the performance measures of a message-passing multiprocessor architecture using artificial neural networks", *Neural Comput. Appl.*, **23**(7-8), 2481-2491. https://doi.or/10.1007/s00521-012-1267-9.

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