

# Application of Recent Developments in Deep Learning to ANN-based Automatic Berthing Systems

Daesoo Lee, Seung-Jae Lee\*, Yu-Jeong Seo

Division of Naval Architecture and Ocean Systems Engineering, Korea Maritime and Ocean University, Busan, Korea

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## Abstract

Previous studies on Artificial Neural Network (ANN)-based automatic berthing showed considerable increases in performance by training ANNs with a set of berthing datasets. However, the berthing performance deteriorated when an extrapolated initial position was given. To overcome the extrapolation problem and improve the training performance, recent developments in Deep Learning (DL) are adopted in this paper. Recent activation functions, weight initialization methods, input data-scaling methods, a higher number of hidden layers, and Batch Normalization (BN) are considered, and their effectiveness has been analyzed based on loss functions, berthing performance histories, and berthing trajectories. Finally, it is shown that the use of recent activation and weight initialization method results in faster training convergence and a higher number of hidden layers. This leads to a better berthing performance over the training dataset. It is found that application of the BN can overcome the extrapolated initial position problem.

**Keywords:** automatic ship berthing, artificial neural network, deep neural network, batch normalization

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\* Corresponding author. E-mail address: [slee@kmou.ac.kr](mailto:slee@kmou.ac.kr)

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