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Adaptive trajectory prediction techniques for active anti-collision forewarning system

Ye Xia[1], Limin Sun[1,2]

[1]Department of Bridge Engineering, Tongji University, Shanghai 200092, China
[2]State Key Laboratory for Disaster Reduction in Civil Engineering, Tongji University, Shanghai 200092, China
Email: yxia@tongji.edu.cn

Abstract

Vessel-bridge collision accidents have been observed frequently in recent years, leading to great necessity of active anti-collision forewarning systems equipped as part of the structural health monitoring system for bridges. As the key technique of the active anti-collision forewarning system, the trajectory prediction of moving vessels is a practical but challenging problem encountered in the engineering field. An adaptive real time prediction approach, based on least square estimation technique, is proposed to practically predict the vessel trajectory using the monitored spatial data of vessels and considering the effect of velocity profile of river fluid. The vessel state vectors are obtained through video monitoring of the main channel and image recognitions. The velocity profile of river flow is plotted with flow speed sensors installed at the bridge piers in combination with fluid theories. Numerical simulations as well as field tests are demonstrated to verify the accuracy and feasibility of the proposed approach framed into the anti-collision forewarning system. The results indicate that the proposed approach can i) effectively consider various external effects for trajectory predictions, ii) accurately predict the trajectory of vesse1s that have no or smooth operations, and iii) adaptively adjust the trajectory predictions for those with abrupt operations.

Key words: Structural Health Monitoring, Vessel-Bridge Collision, Trajectory Prediction, Forewarning System, Least Square Estimation