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An Adaptive Back-Propagation Network and Kalman Filter Based Multi-Sensor Fusion Method for Train Location System

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Abstract : The Global Navigation Satellite System (GNSS) is regarded as an effective approach for the purpose of replacing the large amount used track-side balises in modern train localization systems. This paper describes a method based on the data fusion of a GNSS receiver sensor and an odometer sensor that can significantly improve the positioning accuracy. A digital track map is needed as another sensor to project two-dimensional GNSS position to one-dimensional along-track distance due to the fact that the train's position can only be constrained on the track. A model trained by BP neural network is used to estimate the trend positioning error which is related to the specific location and proximate processing of the digital track map. Considering that in some conditions the satellite signal failure will lead to the increase of GNSS positioning error, a detection step for GNSS signal is applied. An adaptive weighted fusion algorithm is presented to reduce the standard deviation of train speed measurement. Finally an Extended Kalman Filter (EKF) is used for the fusion of the projected 1-D GNSS positioning data and the 1-D train speed data to get the estimate position. Experimental results suggest that the proposed method performs well, which can reduce positioning error notably.

Keywords : multi-sensor data fusion, train positioning, GNSS, odometer, digital track map, map matching, BP neural network, adaptive weighted fusion, Kalman filter
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