Location Uncertainty – A Probablistic Solution for Automatic Train Control

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Abstract : New train control systems rely mainly on Automatic Train Protection (ATP) and Automatic Train Operation (ATO) dynamically to control the speed and hence performance. The ATP and the ATO form the vital element within the CBTC (Communication Based Train Control) and within the ERTMS (European Rail Traffic Management System) system architectures. Reliable and accurate measurement of train location, speed and acceleration are vital to the operation of train control systems. In the past, all CBTC and ERTMS system have deployed a balise or equivalent to correct the uncertainty element of the train location. Typically a CBTC train is allowed to miss only one balise on the track, after which the Automatic Train Protection (ATP) system applies emergency brake to halt the service. This is because the location uncertainty, which grows within the train control system, cannot tolerate missing more than one balise. Balises contribute a significant amount towards wayside maintenance and studies have shown that balises on the track also forms a constraint for future track layout change and change in speed profile.This paper investigates the causes of the location uncertainty that is currently experienced and considers whether it is possible to identify an effective filter to ascertain, in conjunction with appropriate sensors, more accurate speed, distance and location for a CBTC driven train without the need of any external balises. An appropriate sensor fusion algorithm and intelligent sensor selection methodology will be deployed to ascertain the railway location and speed measurement at its highest precision. Similar techniques are already in use in aviation, satellite, submarine and other navigation systems. Developing a model for the speed control and the use of Kalman filter is a key element in this research. This paper will summarize the research undertaken and its significant findings, highlighting the potential for introducing alternative approaches to train positioning that would enable removal of all trackside location correction balises, leading to huge reduction in maintenances and more flexibility in future track design.

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