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A Novel Recurrent Neural Network Soft Sensor via a Differential Evolution Training Algorithm for the Tire Contact Patch

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Abstract

In this paper we propose a novel Recurrent Neural Network Soft Sensor designed to estimate and predict the contact area that tires of a car are making with the ground. This is one of the most critical issues regarding car modelling for improving its performance. The proposed sensor is particularly useful for an active suspension because it allows its suspension to be prepared instead of reacting to a disturbance. The recurrent neural network enables the Soft Sensor to have a correct prediction of the contact area of the tire. This sensor uses data from 11 sensors mounted on the car while the tire contact patch is obtained by means of frustrated total internal reflection phenomenon. The training process of the Recurrent Neuronal Network presents several difficulties caused by the existence of spurious valleys. For this reason, we address this problem as an optimization problem, solved by using a modified differential evolution algorithm. Our Soft Sensor performance is successfully validated by physical experiments under real operation.

Keywords: Recurrent Neuronal Networks, Soft Sensor, Differential Evolution, Tire contact patch.

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