Active Tilting Vehicle Yaw-Tilt Synchronization Control with Ensembled Bpnn-Rnn㊀

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Abstract: When a narrow vehicle drives on a curve route, it is at risk of rolling over due to the centrifugal force applied to its yaw motion. Therefore, an active tilting vehicle should tilt in the opposite direction of centrifugal force when the vehicle is yawing. That the active tilt motion of the vehicle synchronizing with its yaw motion can improve the steering and roll stability of the vehicle. But the tilt motion is slower than the yaw motion due to the tilt damping of the suspension. In order to synchronize the tilt motion with the yaw motion of the vehicle, an approach that controls the tilt angle by the prediction of the yaw rate was proposed. A back-propagation natural network and a recurrent neural network were ensembled to predict the yaw rate of the vehicle. A prototype is manufactured based on the proposed approach. When the prototype is driving on "S"-curve routes and "C"-curve routes, the average lag time of tilt angle is reduced to 0.09s. The synchronization is better in "C"-curves that are closer to actual traffic. Compared with the tilting angle control approach without the prediction, the proposed approach reduces the average lag time by 78.01%. The size of the network model used in the prototype is 3207KB, so the network model can be embedded in a variety of devices. Experiments show that the approach can effectively synchronize the tilt motion with the yaw motion of the vehicle. Experiments also show the practicability of the proposed approach.

Key words: back-propagation natural network, recurrent neural network, active tilting vehicle, synchronous control

㊀ 本书仅收录摘要，全文刊载在《2023 中国汽车工程学会年会论文集精选（*Proceedings of China SAE Congress 2023: Selected Papers*）》（电子出版物，由德国施普林格出版社出版）。