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”DYN1#6 - Unknown load torque estimation on rotary drivetrains with exploitation of angular periodicity in an extended Kalman filter”

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Accurate knowledge of the torsional vibrations is key for condition monitoring, control and design optimization of mechatronic drivetrains. An often applied solution is to combine the knowledge of the system dynamics in the form of a physics-based model with an informative but limited set of measurements in a stochastic estimation algorithm. A critical difficulty in this estimation arises from the external torques acting on the drivetrain. For many rotary drivetrains, these external torques show cyclic behavior in function of the rotational position to some extent. This contribution presents a strategy to exploit such behavior in an augmented extended Kalman filter. The strategy is experimentally validated on a mechatronic drivetrain setup, consisting of a back-to-back induction motor with a cardan axle connection. The root-mean-square error of the estimated load torque with regard to a validation torque sensor is used to compare the results with a conventional estimator. A significant reduction in root-mean-square error is obtained for the new strategy as compared to the conventional augmented Kalman filter for a number of validation experiments. The amount of error reduction is shown to be dependent on the relative contribution of the cyclic term to the overall unknown torque.

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