Kalman Filters for extended state spaces: theoretical and practical challenges.

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PROPOSAL

Objective
This project will investigate how one can extend the Kalman Filter (KF) to high-dimensional state spaces. This solution is a key component in many problems of adaptive and automatic control as encountered by Percy Roc. The successful candidate has to demonstrate feasibility of his solution in a physical setup provided by Percy Roc.

Description
The design of Kalman filters able to deal with extended state spaces is challenging for a number of reasons. This is especially so as the system will stay in its ‘transient state’, and steady-state assumptions are not realistic anymore. Moreover, traditional assumptions as observability and controllability break down: equivalently rank conditions of certain matrices will not often hold in this context. However, the supervisors have initiated similar research already in [1], outlining a number of main ideas based on ideas in machine learning. The requirement for a physical demonstrator of this work ensures its value for Percy Roc.

Interdisciplinary
This research challenge is truly interdisciplinary: on the one hand the candidate should gain fluency in the mathematical developments behind state observers, and investigate conditions as observability in this context. This line of mathematical developments is well-established since the late 60s. Yet the area of high-dimensional statistics is recently reshaped by developments in linear algebra, using techniques of randomisation. On the other hand, the requirement for a physical demonstrator of the technology ensures that this investigation would be firmly rooted in reality.

Financing
This project will be supervised by
• Kristiaan Pelckmans, associate professor at UU/IT, division of Systems and Control (SysCon).
• Dragos Dancila, associate professor at UU/EE, division of Solid State Electronics.
• Percy Roc AB (https://www.percyroc.se/), a young startup supported by Vinnova, UIC, InnoEnergy, a.o.

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