DC Number	DC2
Title of the PhD Project	Robust procedures for state estimation of uncertain systems with disturbances attenuation
Keywords	Robust state observation, H-infinity control, dissipativity theory, modulating function method
Recruitment organisation	TU Ilmenau
Supervisors names and contacts	Johann Reger (johann.reger@tu-ilmenau.de)
Scientific context and objectives	The project addresses the problem of reconstructing the state of components of energy systems for models subject to uncertainty and external disturbances. Recent methodologies from robust state observer design shall be enhanced to also encompass structured uncertainties. The new approach invokes ideas from robust control theory, that is, H-infinity control, and the corresponding nonlinear extensions, as for example, L2-gain and dissipativity theory. A further line of research will be the development of such estimation tools by using the modulating function method. The overall goal is to estimate the system state without the necessity to estimate the related uncertainties and disturbances. Solutions of respective optimization problems shall be carried out in a pre-processing stage, i.e. with low computational burden during run-time. We strive for finding guidelines for the selection and tuning of the estimator parameters and provide discretized reduced-order versions of the algorithms. TU Ilmenau plays a leading role in the development of robust state and parameter estimators for systems modeled as linear and nonlinear differential equations. The DC will be integrated in the Control Engineering Group at the Faculty of Computer Science and Automation and also work in close interaction with the Systems Theory Group at the Institute of Mathematics.
Required skills	• Master degree in Systems and Control Engineering or comparable qualification • Sound knowledge in robust control, state observer design, and dissipativity theory • Profound knowledge in Matlab/Simulink • Ability to work scientifically, independence, flexibility, teamwork and communication skills • Desire for professional and personal development, possibly for a doctorate • Very good knowledge of English and, if possible, German
References	[1] D. Zhang, J. A. Moreno, J. Reger, “Homogeneous L_p Stability for Homogeneous Systems”, IEEE Access, Volume 10, 81654-81683, 2022. [2] M. Noack, J. Reger, J. Jouffroy, “Adaptive Velocity Estimation for Lagrangian Systems using Modulating Functions”, IEEE International Conference on Mechatronics, Loughborough, United Kingdom, 2023. [3] M. Noack, I. N’Doye, J. Reger, T.-M. Laleg-Kirati, “Modulating function based algebraic observer coupled with stable output predictor for LTV and sampled-data systems”, Automatica, January 2024 (under review), DOI: 10.48550/arXiv.2401.14988 [4] B. Voß, J. A. Moreno, J. Reger, “Minimizing the Homogeneous L2-gain of Homogeneous Differentiators”, European Control Conference , November 2023, DOI: 10.48550/arXiv.2311.10519

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