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My talk is concerned with the asymptotic stability analysis of the nonlinear filter. The analysis is closely based on duality between estimation problem and the optimal control problem.

The stability analysis of the Kalman filter relies, either direct or indirect manner, on duality theory: the asymptotic stability of the Kalman filter is related to the asymptotic stability of the (dual) optimal control system, and therefore the necessary and sufficient conditions for the Kalman filter is given by the controllability of the control system, which is equivalent to the detectability of the model due to the duality.

Meanwhile, it has been considered that the duality theory is an artifact of linear Gaussian theory, and the duality theory had never been considered for both in the definitions of stochastic observability and in the stochastic filter stability analysis. In my talk, I will relate the observability and ergodicity with the (dual) optimal control problem, and propose a slightly strengthened assumption to achieve filter stability property.