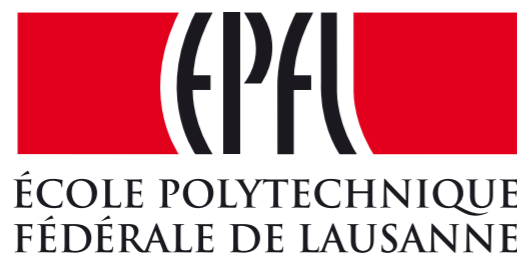
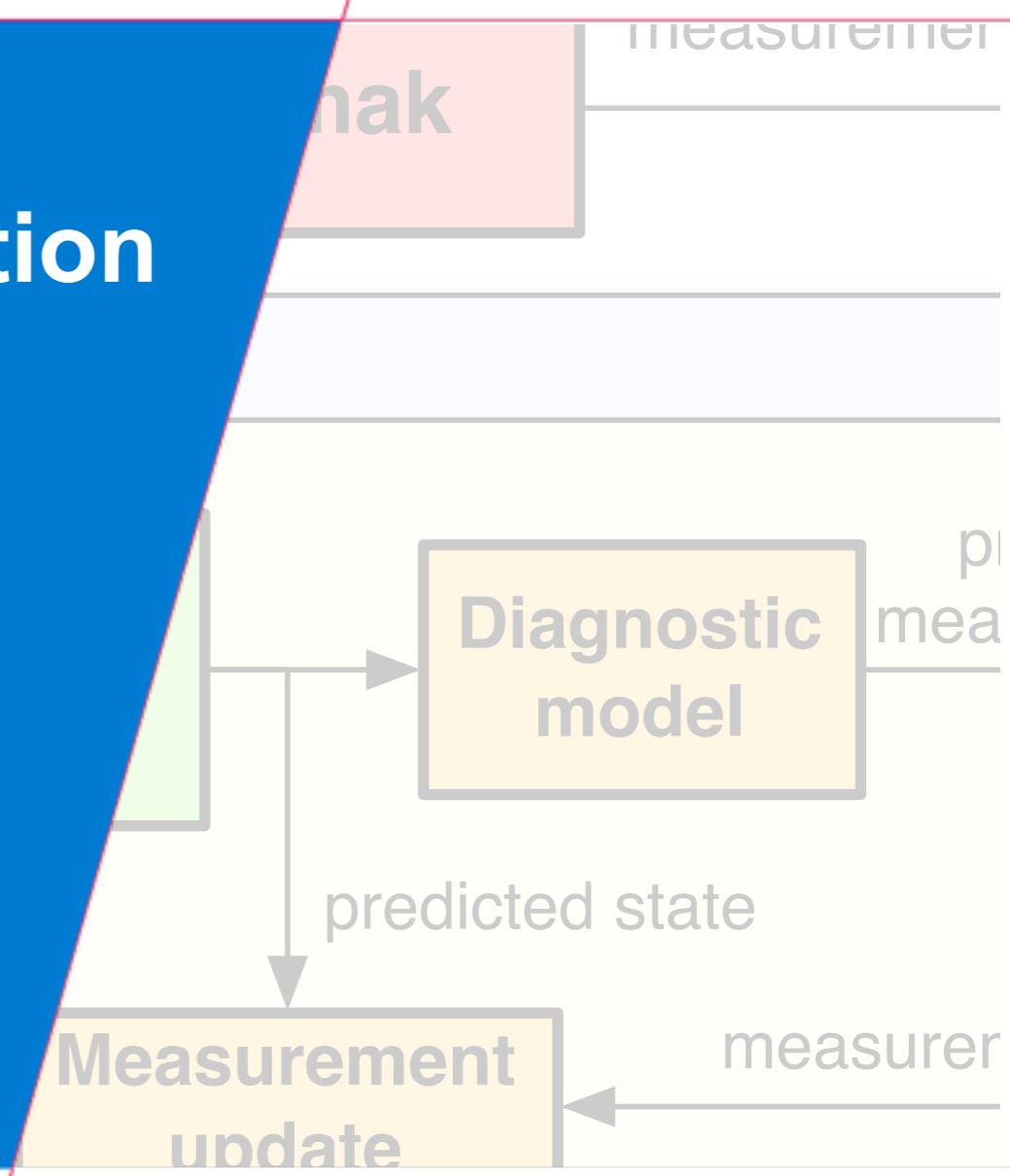


RAPTOR-based real-time observer: first ITER demonstration

Federico Felici

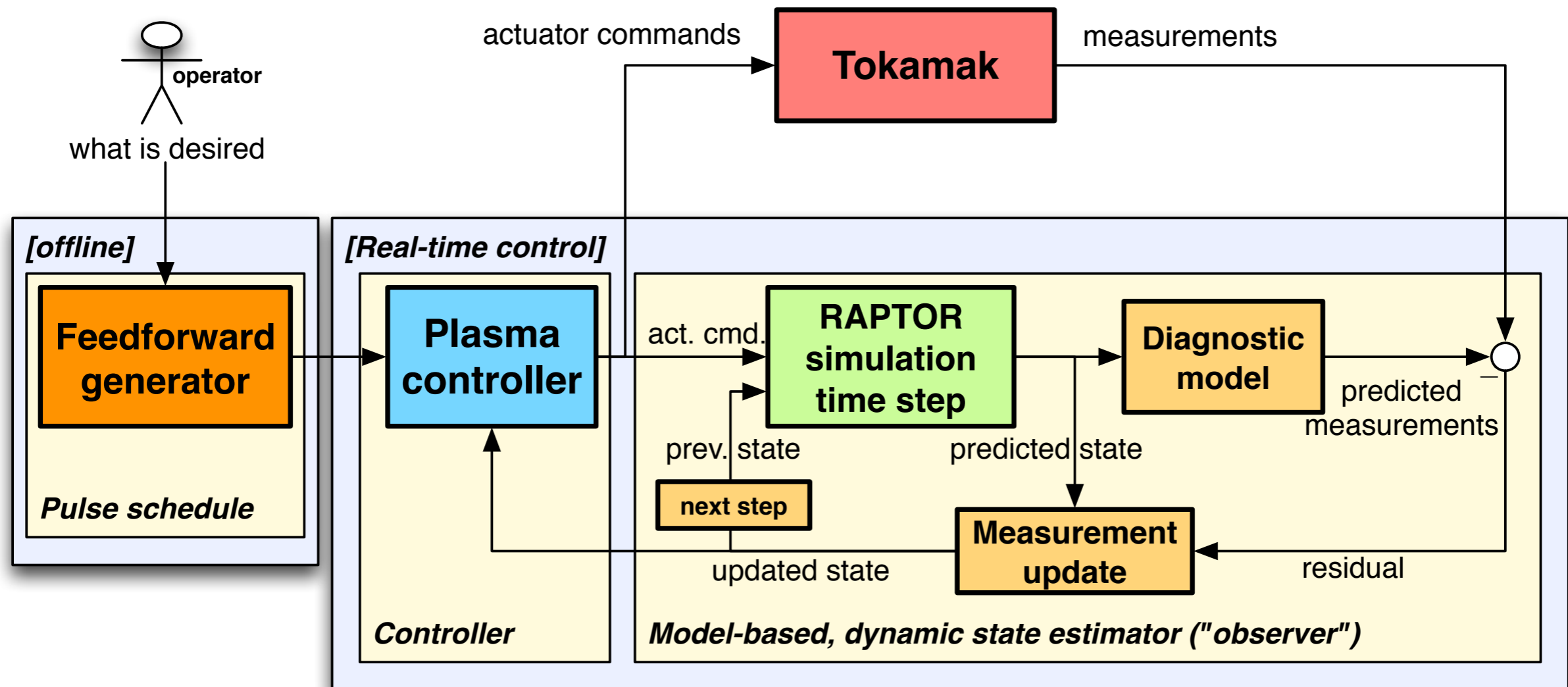
Eindhoven University of Technology (The Netherlands)
Department of Mechanical Engineering
Control Systems Technology Group



Technische Universiteit
Eindhoven
University of Technology

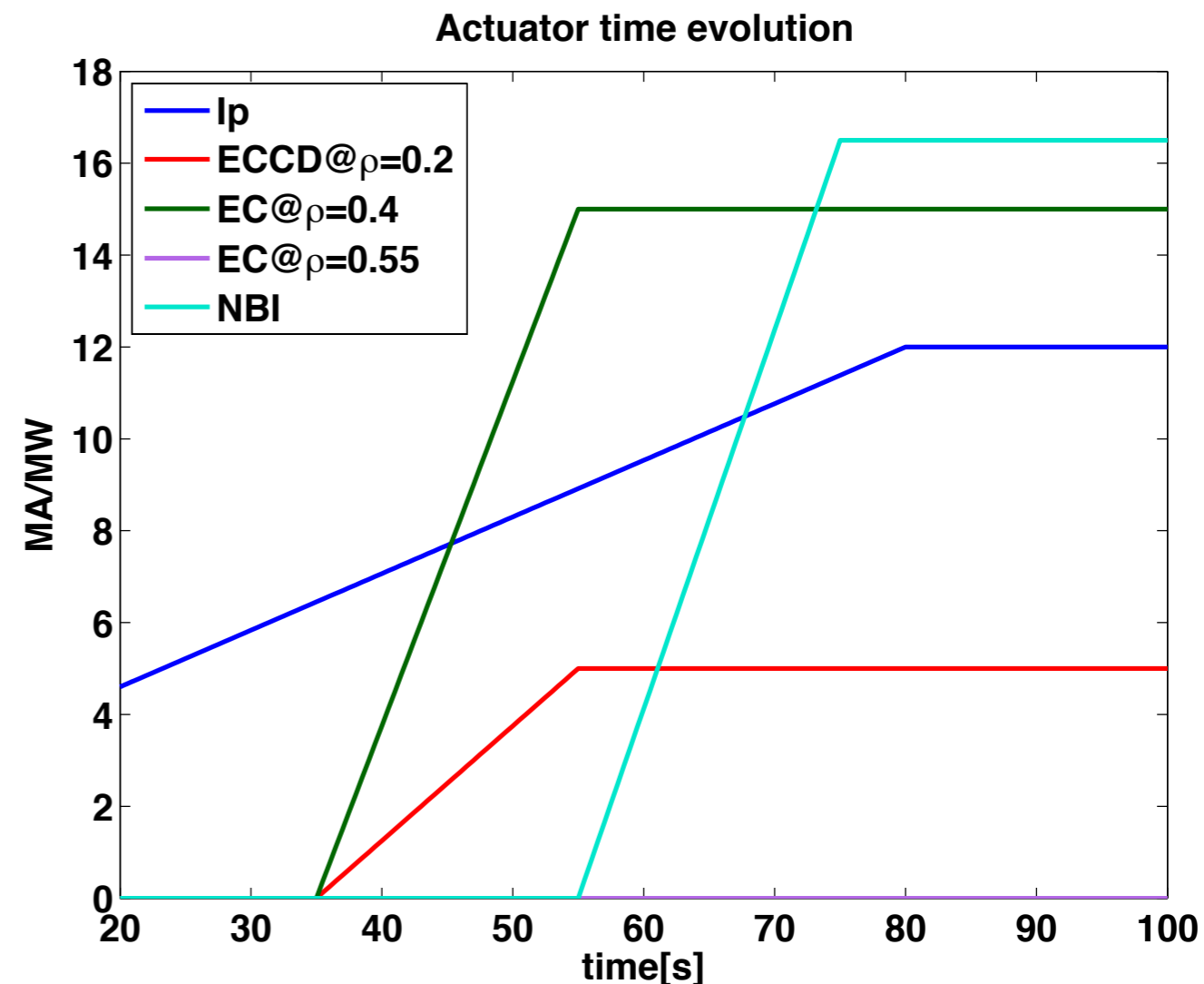
Predict next plasma state with model, correct by diagnostic measurements

- **Components of model-based state observer**
 - Forward simulator (predict state one step ahead)
 - Diagnostic model (predict measurements from predicted state)
 - Measurement update (correct state based on actual measurements)



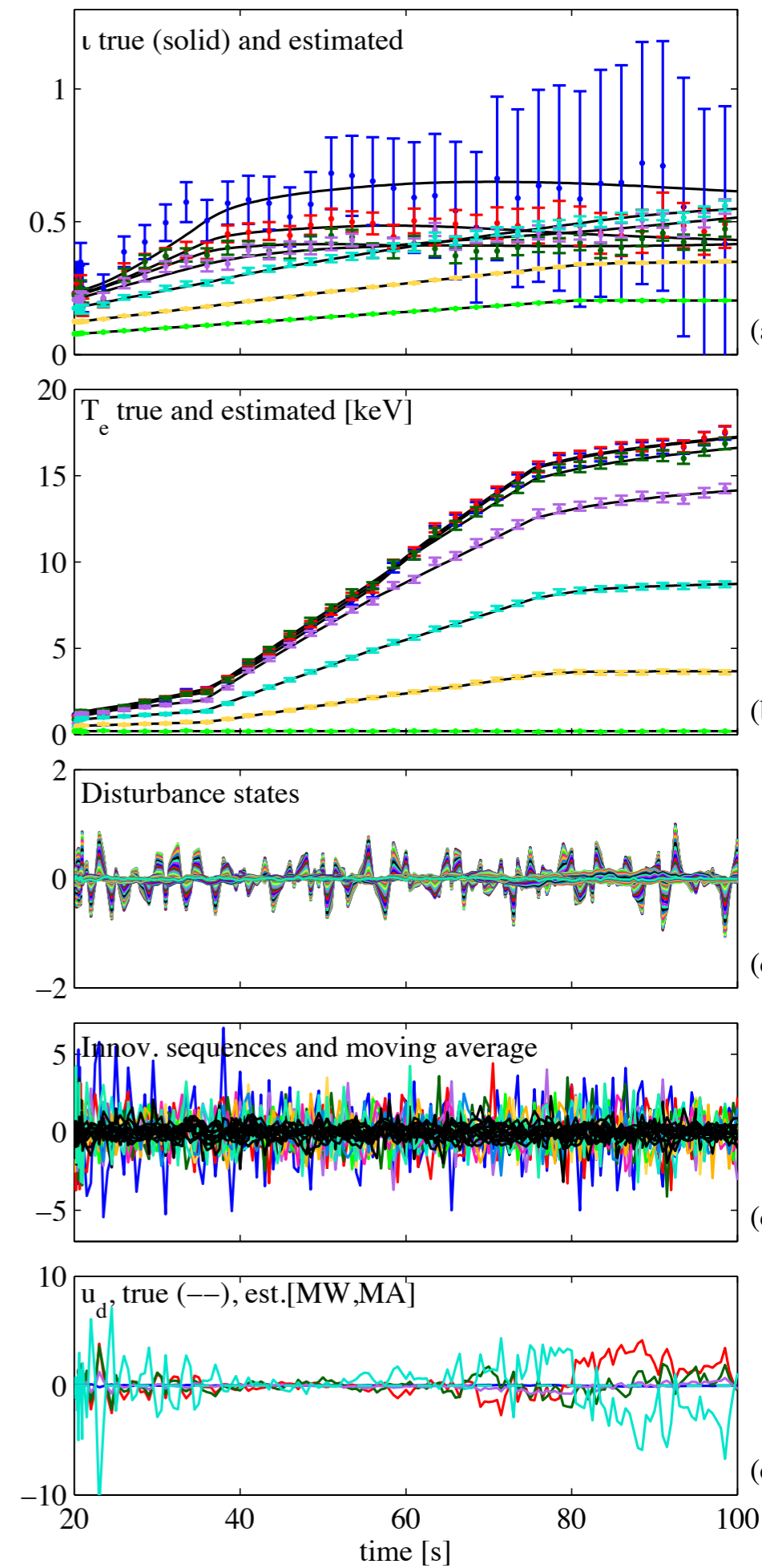
ITER scenario simulation example

- Monotonic I_p ramp-up to 12MA
- NBI and EC heating
- Artificial measurements:
 - I_p : error std 10kA
 - $\Psi(\text{edge})$: error std 0.1[Wb]
 - 5 ECE points spread radially [0.1-1]: error std: 10%
 - 5 measurements of $1/q$ spread radially [0.1-0.6]: error std: 0.05



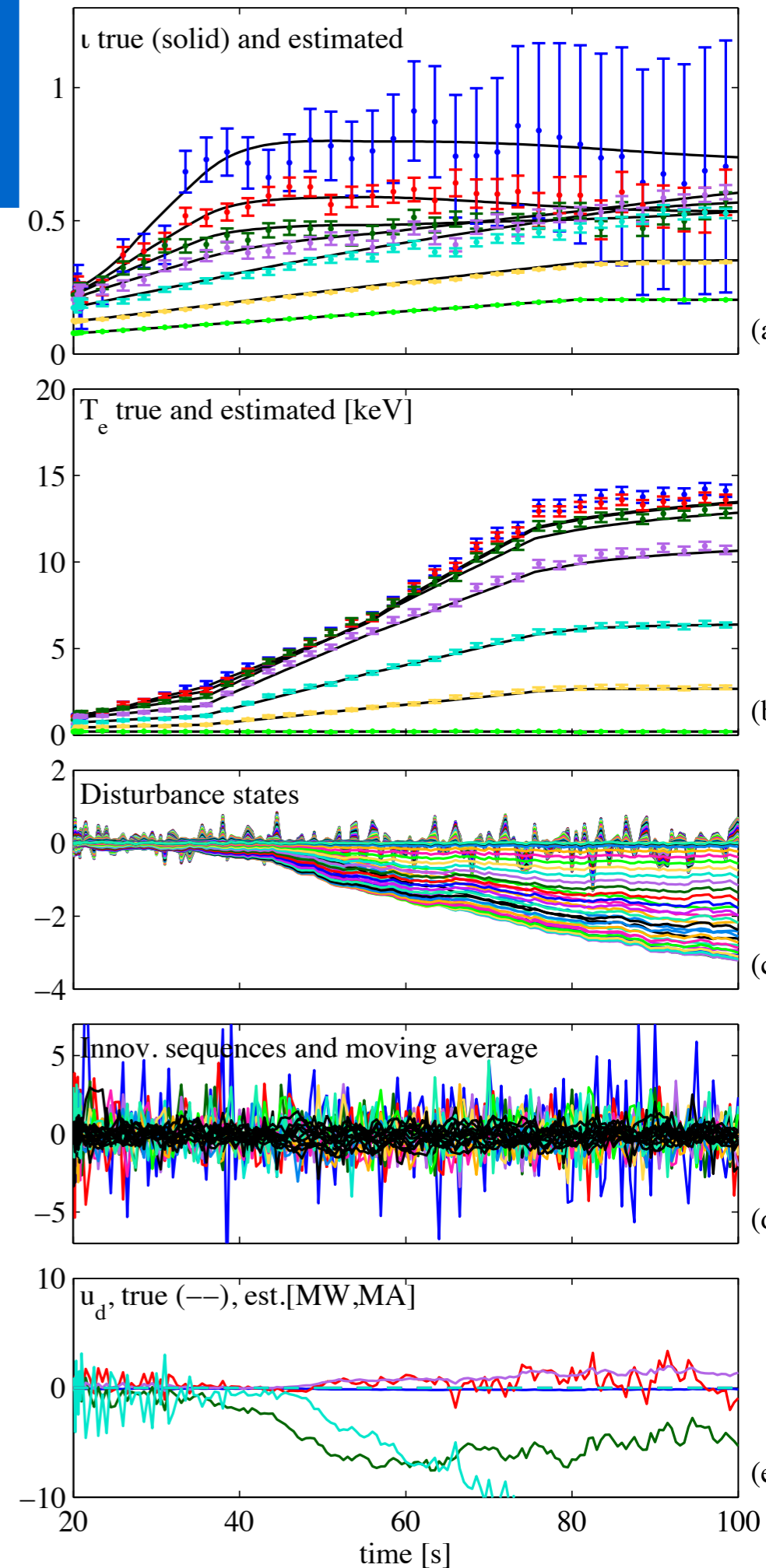
Default: no perturbations

- **Observer model = Simulation model**
- **Note large errorbar on $1/q(0)$**
 - **lower error towards edge**
- **Disturbance states zero-mean**



Perturb: BgB model parameter + 50%

- **Disturbance states accumulate due to difference between observer model and simulation model**



Case 3: input disturbance

- Perturb actuators
- Disturbance structure reflects effect of actuators

