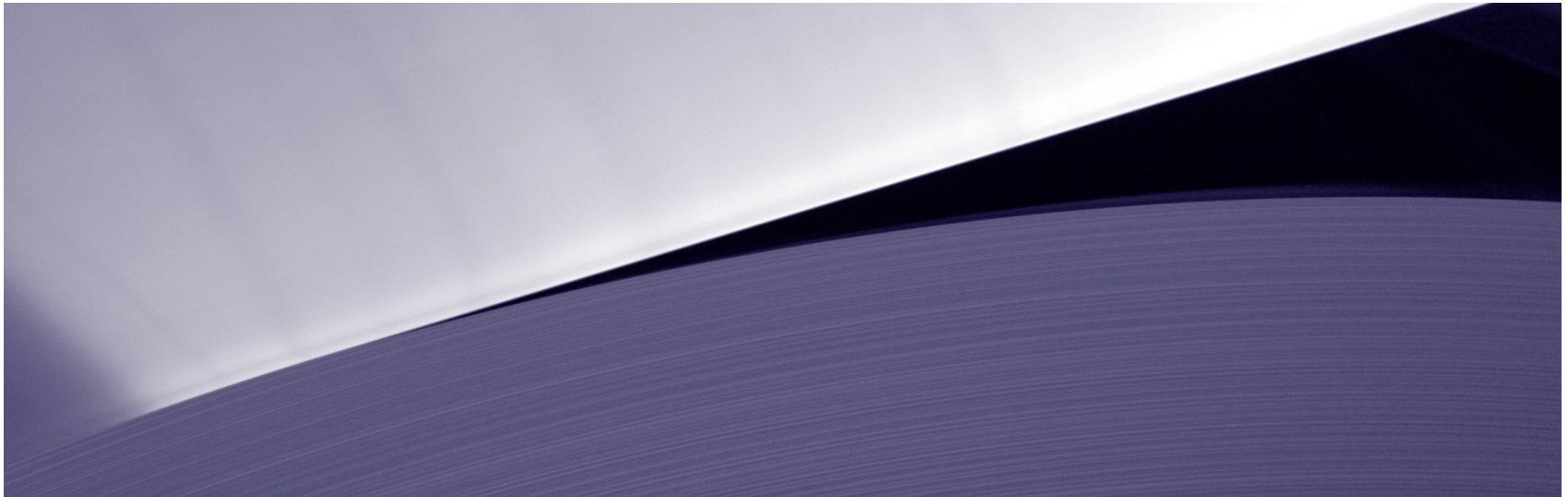


Das virtuelle Walzwerk – Weg zum Cyber-Physical System

Dr. Maksim Klinkov



Outline

- 
- (1) Achenbach Buschhütten – a family company**
 - (2) Rolling mill - challenges in optimization**
 - (3) Cyber mill - architecture**
 - (4) HiL possibilities - R&D and problem solution tool**

Family Company

Achenbach is one of the oldest family companies in Germany.



Today Achenbach is a system supplier for non-ferrous rolling mills and foil slitting machines:



15.06.2018

THE VIRTUAL ROLLING MILL

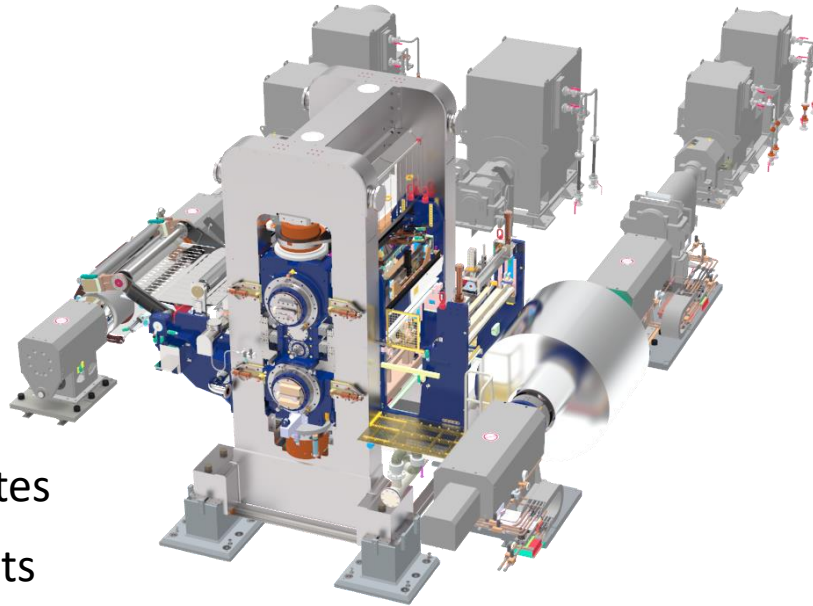
Rolling mill - challenges in optimization (1)

Objective:

- **Stable processes**
- **Short commissioning time**

Challenges:

- **Machine complexity**
 - mechanical
 - electrical
 - hydraulic/pneumatic aggregates
 - and measurement components



Rolling mill - challenges in optimization (2)

Objective:

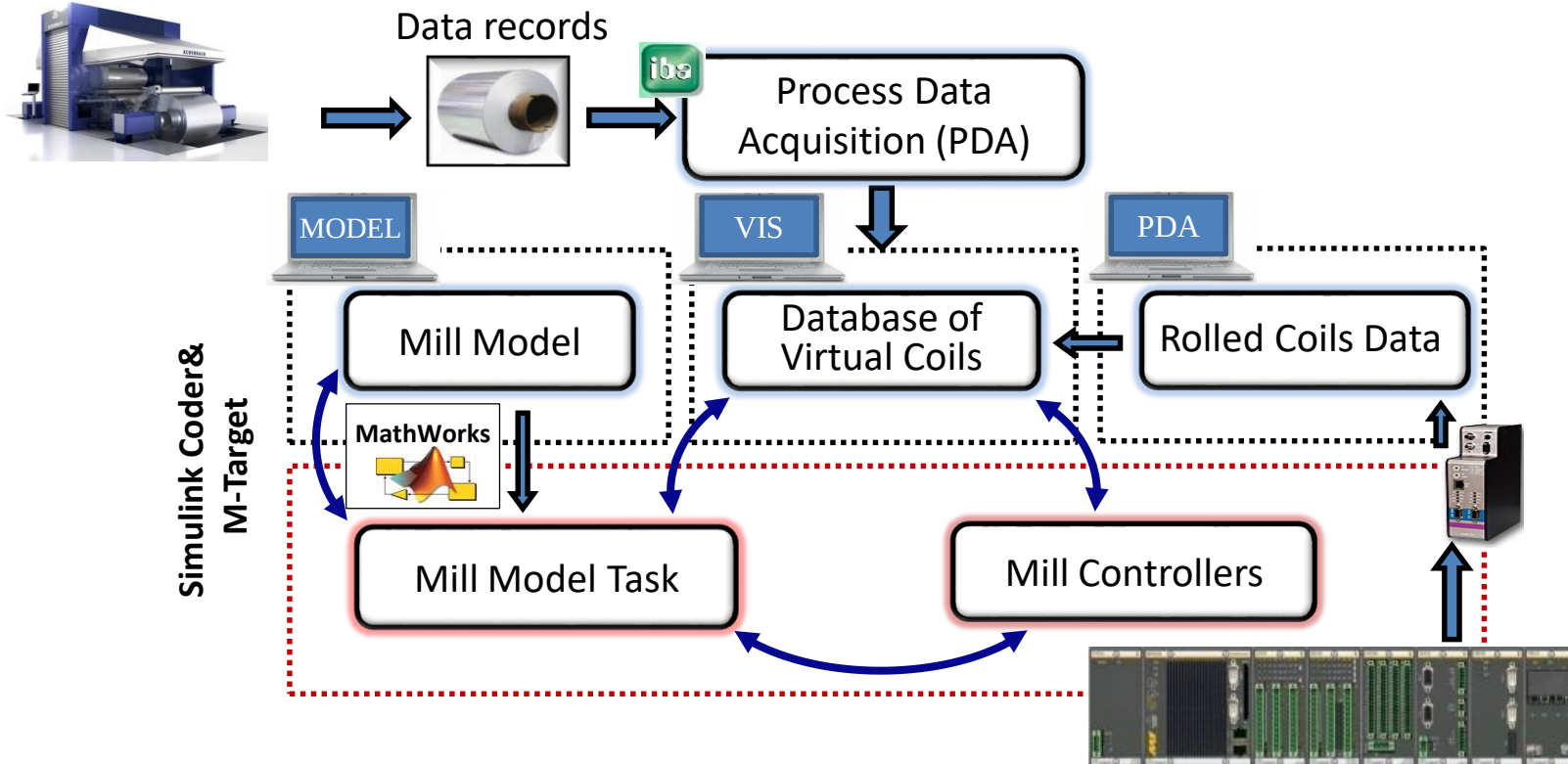
- 7/24 availability
- highest quality by fast production

Challenges:

- **Highly dynamic process** (fast speed 2500 m/min, huge masses 32t coils)
- **Minimum failure tolerances - high costs** (scrap material, outage)



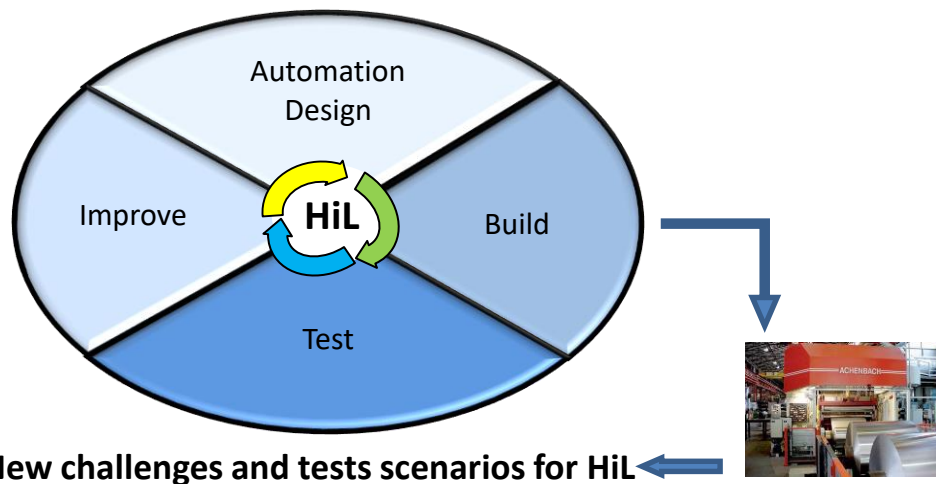
Cyber mill architecture (1)



Cyber mill architecture (2)



HiL possibilities - R&D and problem solution tool



R&D

- New controllers design and test
- Generation of virtual data
- Better understanding of rolling physics
- Faster commissioning
- Failure probability reduction

Troubleshooting and Learning tool

- Modeling and replaying of new situations
- Validation of detected problems
- Scrap free practice for mill Operators maintenance personal





Thank you for your kind attention – Keep On Rolling!

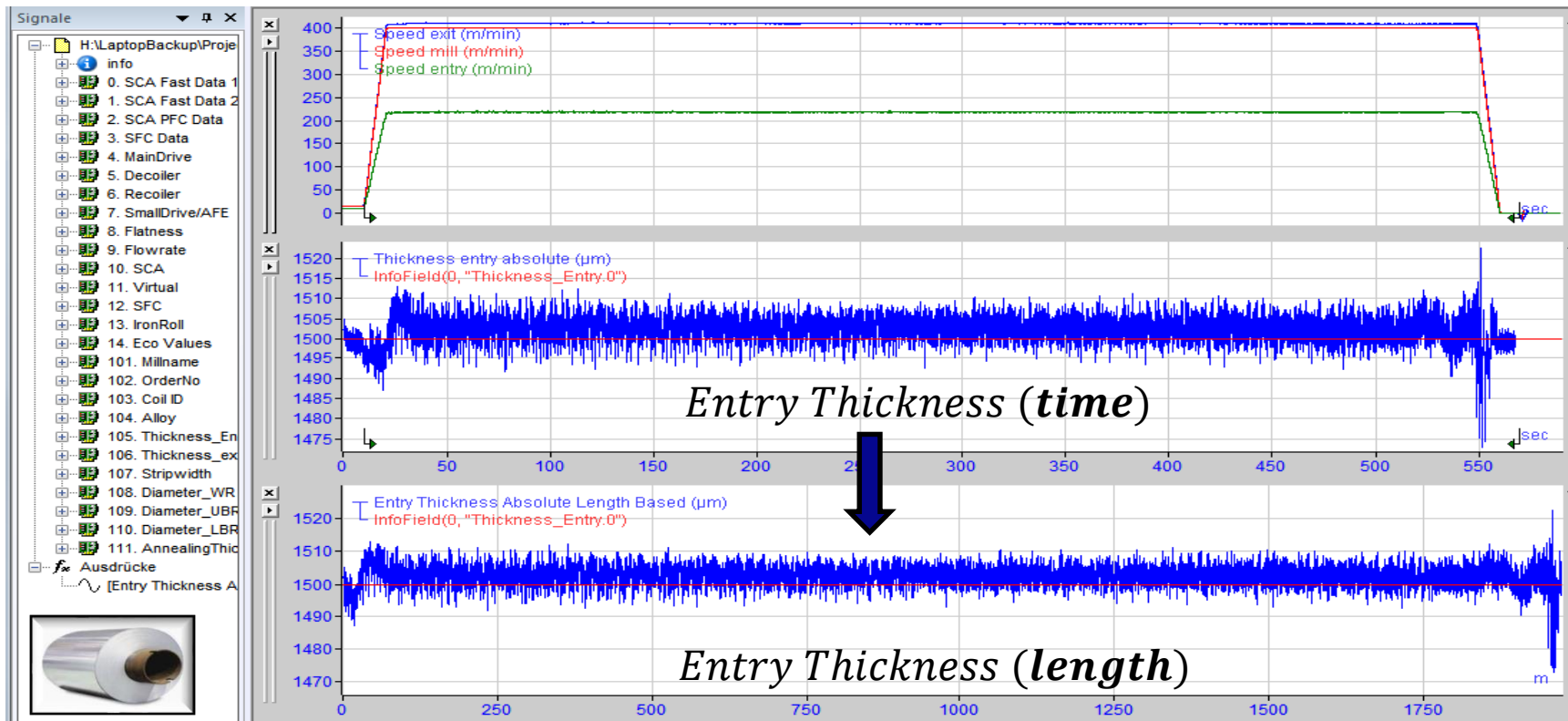
Dr.-Ing. Maksim Klinkov

Head of Automation

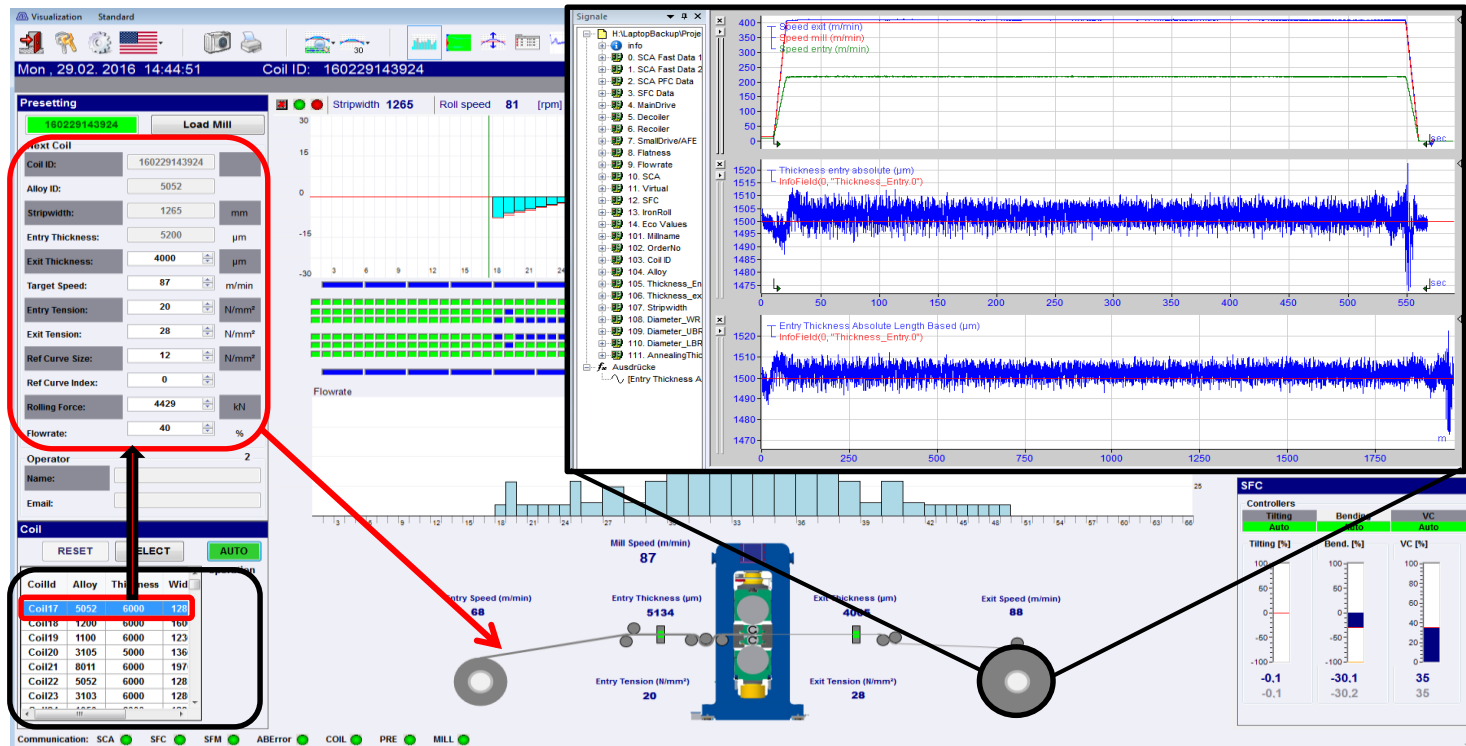
Tel.: +49(0)2732/799-373

E-Mail: m.klinkov@achenbach.de

Process data acquisition



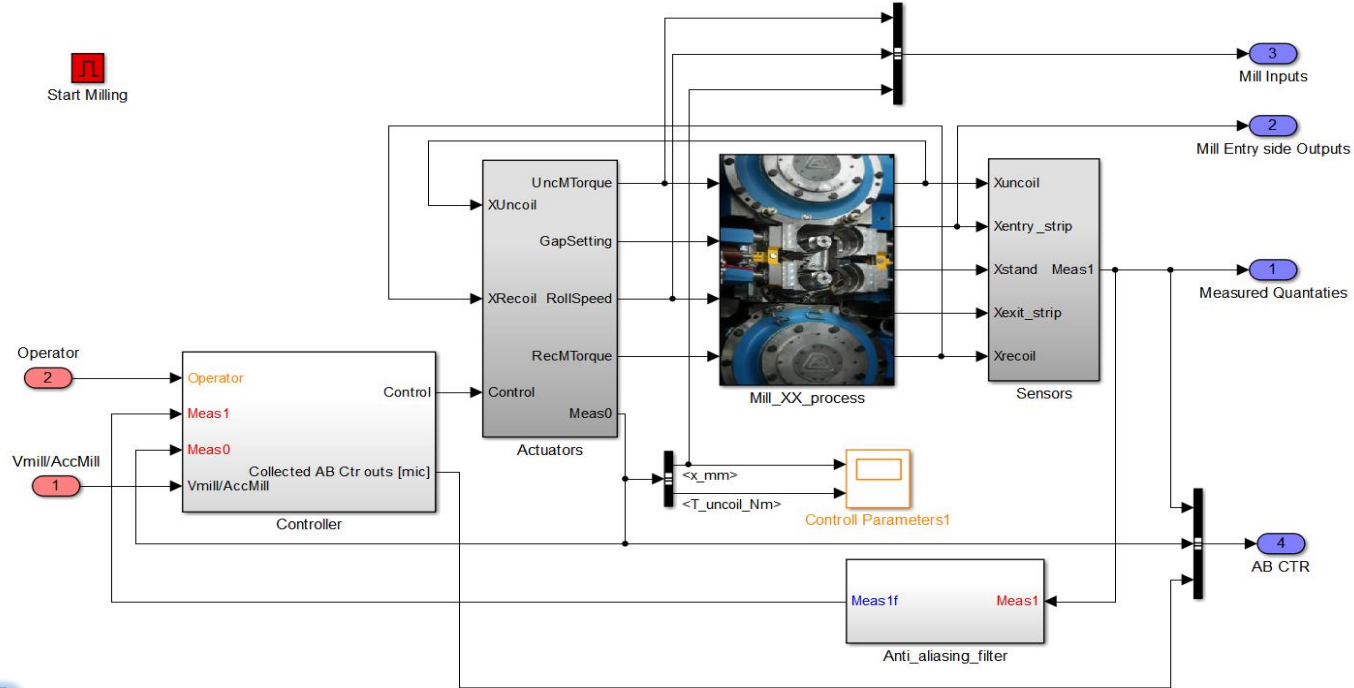
Mill HMI and coils handling DB



Database of
Virtual Coils

Mill model - time varying model (1)

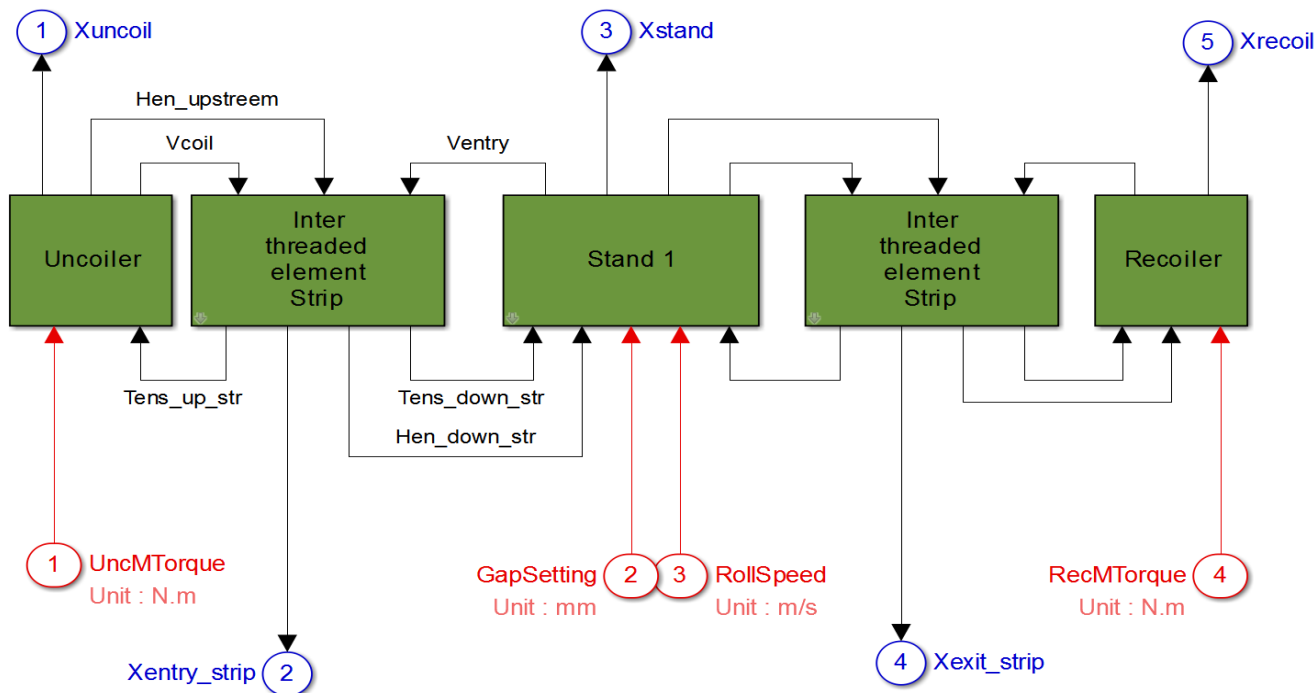
Internal model



Mill Model

Mill model - time varying model (2)

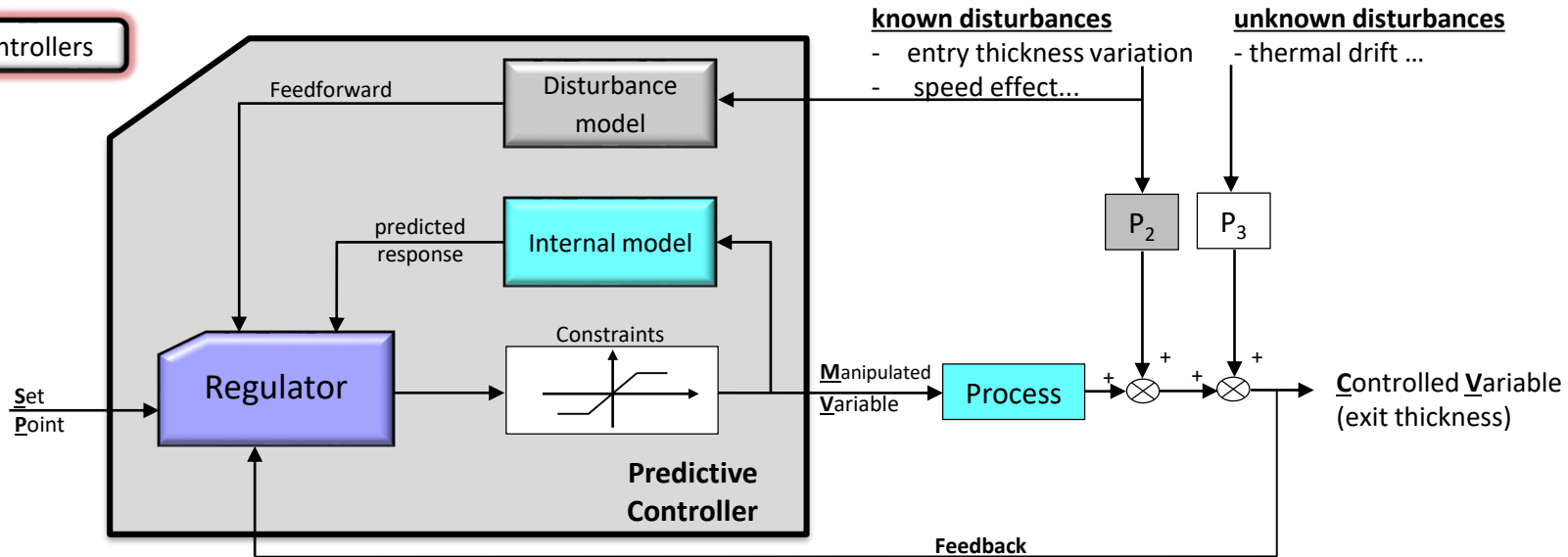
Internal model



Mill Model

PFC – Model Based Predictive Gauge Control

Mill Controllers



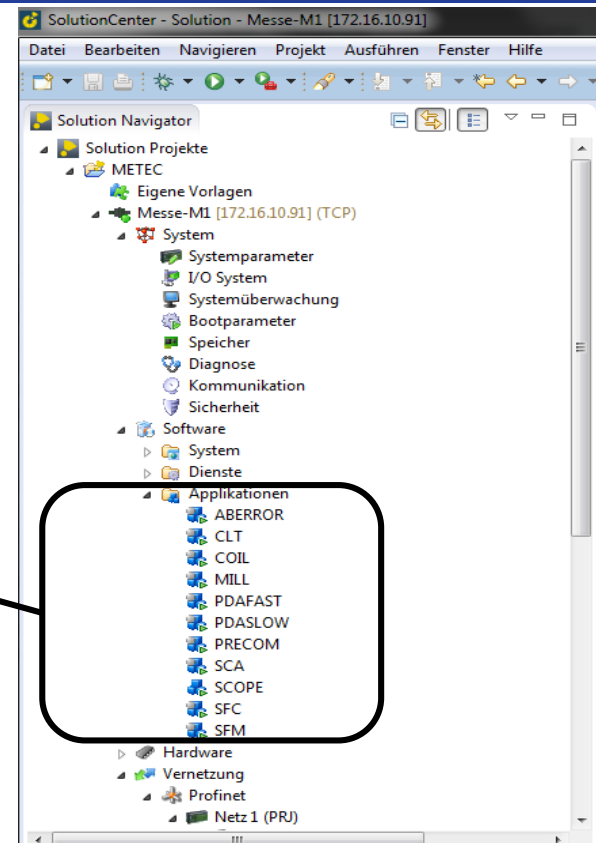
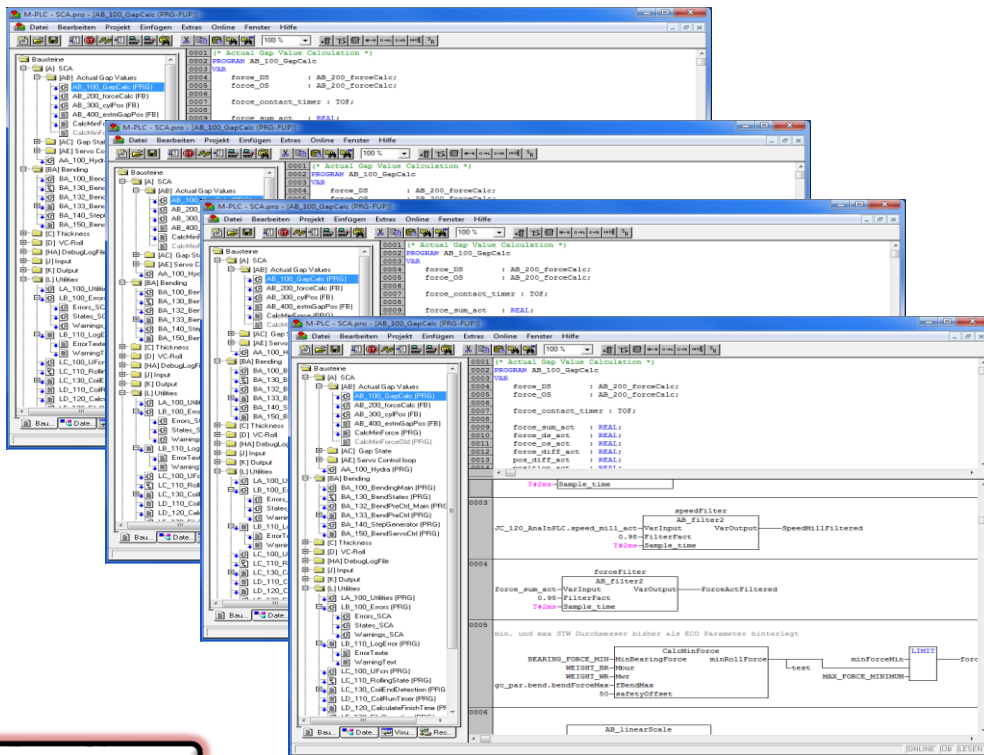
Controller models constructed based on:

- physical principles (mill stand, actuators and sensors dynamics)
- heuristic principles (speed effect – disturbance model)

Regulator algorithm computes a sequence of future actions (MV's):

- to minimize an "objective" function (Gauge error)
- to respect the constraints (actuators)

Mill controllers



Mill Controllers

15. Juni 2018

THE VIRTUAL ROLLING MILL