

Control system: modeling

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Control system modeling

- Identify components in the control loop
=> Block diagram
- System identification
=> Transfer function measurements of individual components
=> Loop transfer function measurements
=> Frequency (= laplace) domain modeling of the components
- Loop performance analysis
- Noise analysis

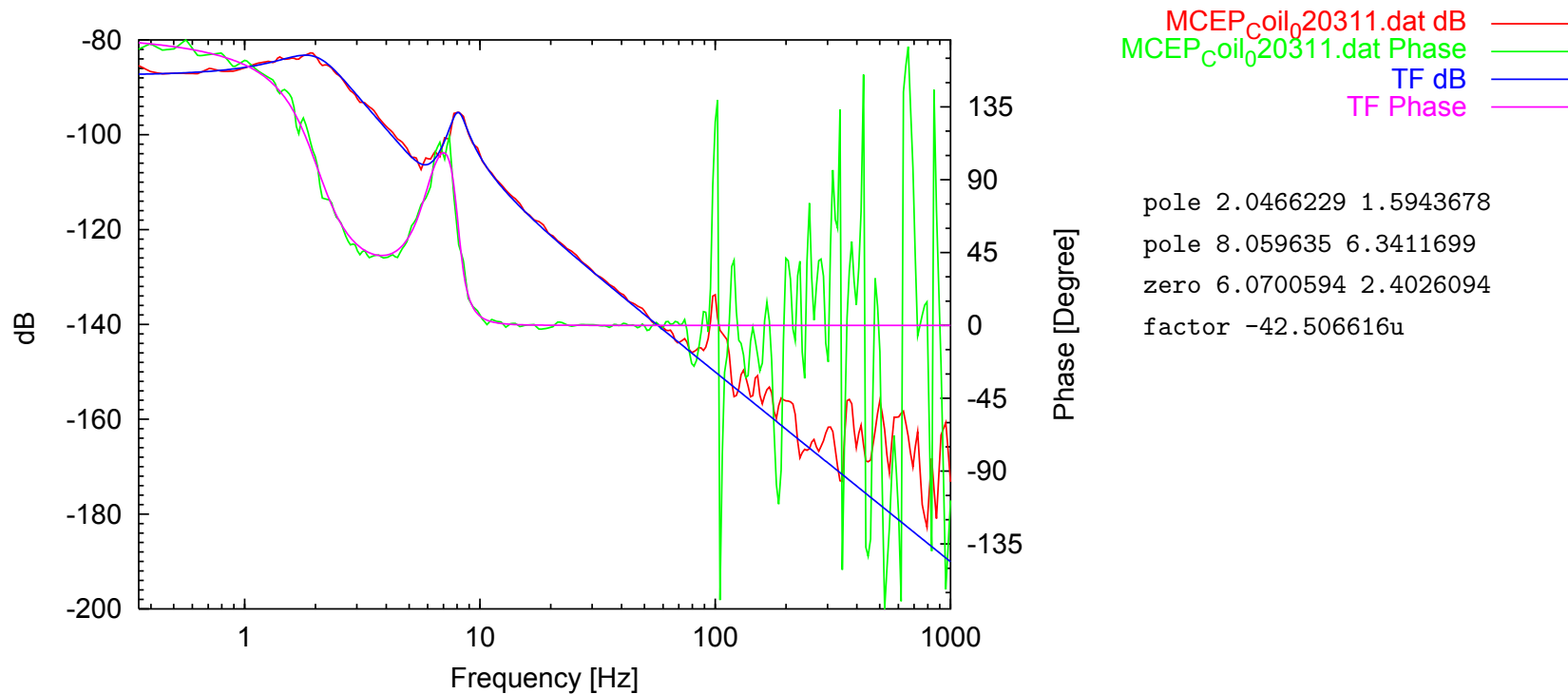
Control system modeling

- **System identification**

- => Transfer function measurements of individual components

- => Frequency (= laplace) domain modeling of the components

MC Pitch Coil



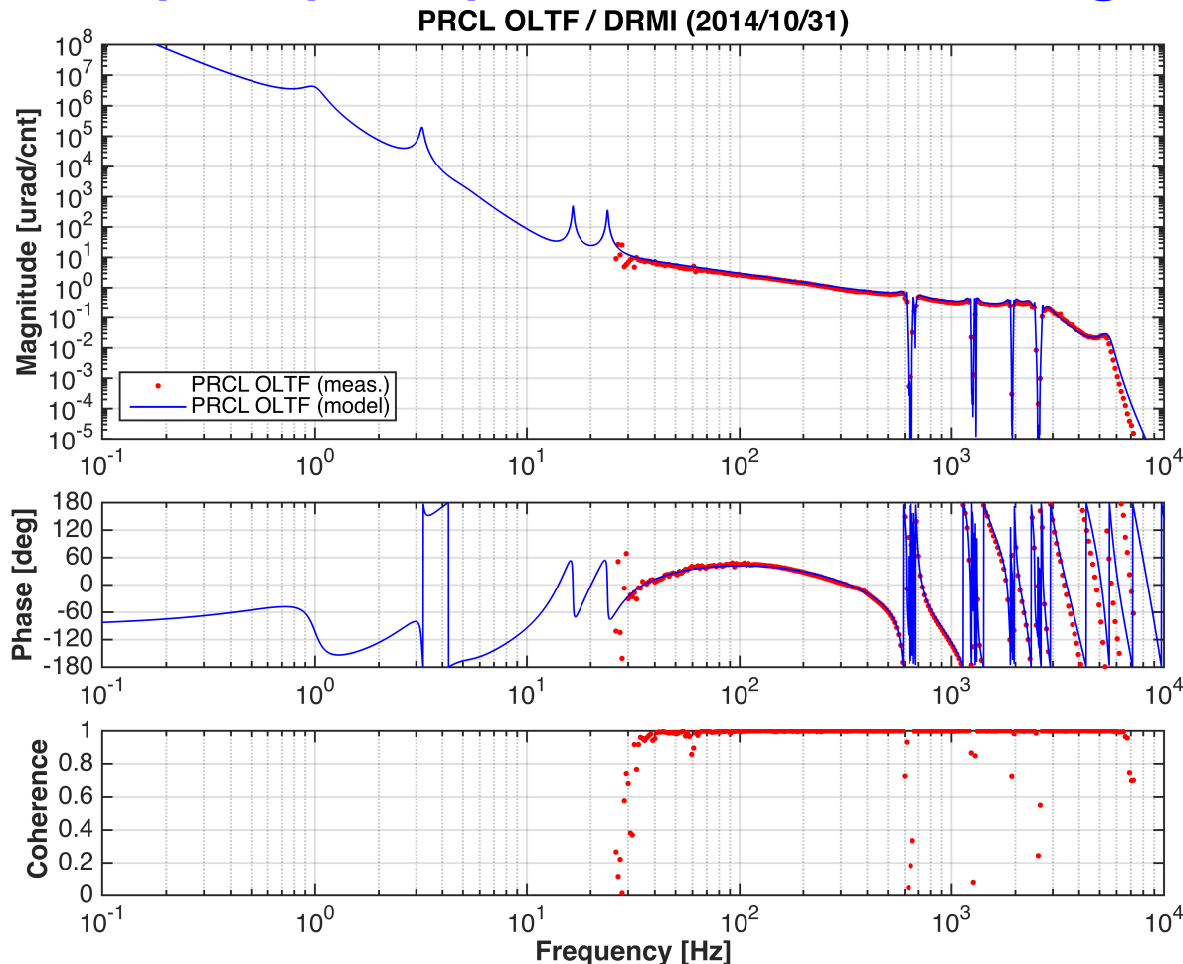
- **Typical tools: vectfit (matlab), LISO**

Control system modeling

- System identification

=> Loop transfer function measurements

=> Frequency (= laplace) domain modeling of the components



**<=40m prototype
power recycling
cavity loop
characterization**

Control system modeling

- An example of the noise estimation project
 - Frequency stabilization control (TAMA300)

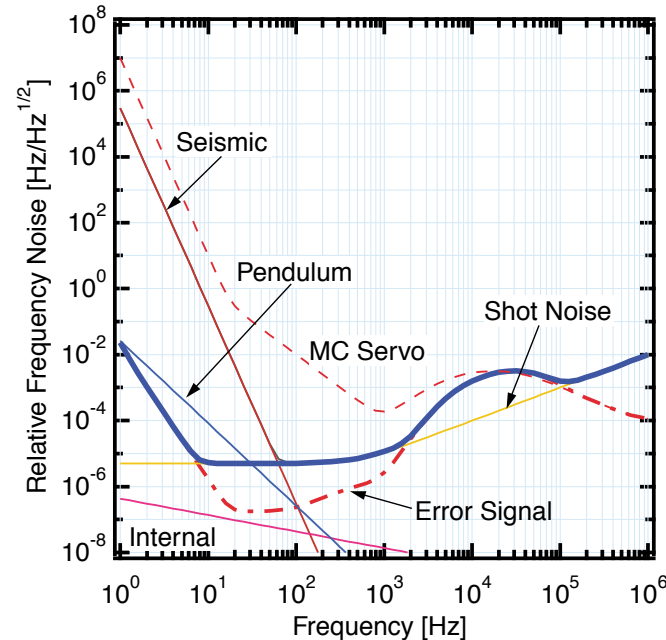


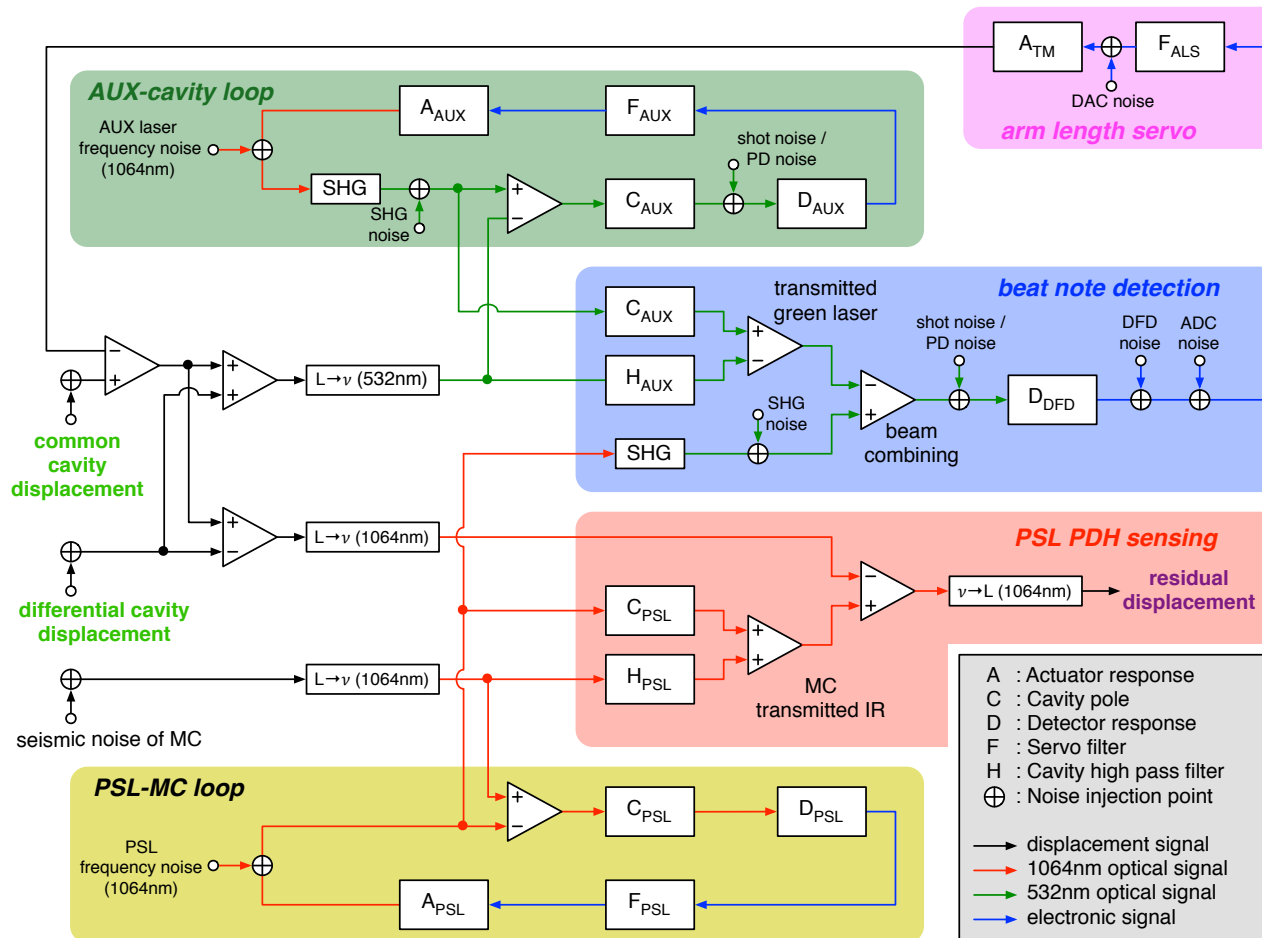
Figure 8.6: Noise estimation of L₊ Servo: Seismic; seismic noise, Pendulum; thermal noise of pendulum, Internal; thermal noise of mirror internal, Shot noise; laser shot noise, Error Signal; error signal of L₊ servo; MC Servo, frequency noise of the transmitted light through the mode cleaner.

Shigeo Nagano et al., "Development of a multistage laser frequency stabilization for an interferometric gravitational-wave detector ", Rev. Sci. Instr. 74, (2003) 4176-4183

Shigeo Nagano, Ph.D thesis, Univ of Tokyo (1999)

Control system modeling

- An example of a complicated block diagram
 - Arm Length Stabilization control (green locking)



Control system modeling

- An example of a complicated noise estimation project
 - Arm Length Stabilization control (green locking)

