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An on-line compensation of input additive disturbances: an evolving Gaussian process models approach

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Motion control

\[ M(q(t))\ddot{q}(t) + F_0(q(t), \dot{q}(t)) = u(t) \]

Known forces
First principles

\[ F_1(q(t), \dot{q}(t)) \]

Unknown disturbances
Nonlinear, time-varying
Data-driven modeling

Case study: compensation of input additive disturbances for servo positioning system

How to compensate for disturbance, i.e., to estimate \( w(t) \)?

Nonparametric regression, e.g., LLR or GPR + Efficient on-line learning

Figure 1: Servo positioning system with mechanical friction brake that can be manually engaged. The additional mass can be added for the gravity compensation experiment.

\[ M(\cdot)\ddot{q}(t) + F_0(\cdot)\dot{q}(t) = u(t) \]

known dynamics
unknown disturbances

\[ u(t) = u_n(t) + w(t) \]

nominal control (PD)
disturbance compensation

Nonparametric regression for disturbance compensation

Efficient on-line learning of disturbances;
Selection of input/output regressors.

References


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