Advanced identification and control for thermal systems

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Advanced Identification and Control for Thermal Systems

Thermal Deformations

Challenges:
- Accuracy: Deformation induced by thermal gradients
- Thermal control less developed compared to mechanical [1]

Modelling for thermal control:
- Error compensation [2]
- Active control
- (Non-)parametric modelling

Next big step in FRF identification [3]

Key challenges in system identification:

\[ Y(k) = G(e^{i\omega k})U(k) + T(e^{i\omega k}) + V(k) \]

Transient dynamics
- Mechanical: O(10 s)
- Thermal: O(10 min)

Proposed approach:

Local Rational Method with Prescribed Poles (LRMP)

Local window around a DFT bin \( k \) such that locally

\[ G(e^{i\omega k+r}) = \sum_{b=1}^{Nb} \theta_b B_b(e^{i\omega k+r}) \]
\[ T(e^{i\omega k+r}) = \sum_{b=1}^{Nb} \theta_b T_b B_b(e^{i\omega k+r}) \]

where \( B_b(e^{i\omega k}) \) are (rational) basis functions

\[ B_b(z) = \left(z \prod_{k=0}^{b-1} \frac{1-z_k}{z-z_k} \right) \prod_{k=0}^{b-1} \frac{1-z_k}{z-z_k} \]

where \( \zeta = \{\zeta_0, \zeta_1, \ldots, \zeta_p\} \) are the pre-specified poles for the all-pass functions.

References