Automatic container model crane

Gruppe 633

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Communication

Force estimation

Improvements

► Requirement for force feedback: 1000 Hz

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► Maximum for the initial system: 100 Hz

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- ▶ Requirement for force feedback: 1000 Hz
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- ▶ Our approach:

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Communication 2

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- ▶ Maximum for the initial system: 100 Hz
- ▶ Our approach:
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  - ▶ Changing the transport protocol
- ▶ Results: maximum of 638 Hz

Communication

Force estimation

Improvements

- ▶ Model approach
- ▶ Nonlinearities in the EndoWrist dynamics
  - ▶ Hammerstein Wiener Models

u(t) → [Input Nonlinearity] → w(t) → [Linear Block] → x(t) → [Output Nonlinearity] → y(t)

Figure : Hammerstein-Wiener model.

- ▶ Linear model
  - ▶ Choice of inputs affects model quality
  - ▶ Inputs: effort, velocity
  - ▶ Outputs: force
- ▶ Black-box identification
  - ▶ Subspace identification
  - ▶ Hankel singular value analysis

Include picture with effort force fit here!!

- Input and output nonlinearities
  - Effort
  - Force

Include picture with effort force fit here!!

- ▶ Nonlinearities
  - ▶ Deadzone nonlinearities
  - ▶ Input/Output -saturation

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State estimation

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Force estimation

Improvements ⑧

▶ Modeling for additional outputs allows correction of the model using an estimator

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Force estimation

Improvements 8

▶ Modeling for additional outputs allows correction of the model using an estimator

▶ A multiple output model that adequatley captures the dynamics of the system could be used in a Kalman filter to create a state estimate

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► Modeling for additional outputs allows correction of the model using an estimator

► A multiple output model that adequatley captures the dynamics of the system could be used in a Kalman filter to create a state estimate

► The state estimates can be used in a state feedback loop to change system dynamics

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Improvements 8

- ▶ Modeling for additional outputs allows correction of the model using an estimator
- ▶ A multiple output model that adequatley captures the dynamics of the system could be used in a Kalman filter to create a state estimate
- ▶ The state estimates can be used in a state feedback loop to change system dynamics
- ▶ This means that reference following capabilities can be added to the system, dispite the nonlinear characteristics of the dynamics

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Communication
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Improvements

- ▶ The hypothesis was tested in simulation
- ▶ Simulation results show that full reference following is possible despite the input nonlinearities in the system
- ▶ While the transient behaviour of the reference value is replicated, offsets and parasitic gains need to be compensated
- ▶ Could be implemented with improved model, doesn't improve estimate of current one.