# An overview of my licenciate thesis, Control, Models and Industrial Manipulators

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# My licenciate – Two main themes

- Control of industrial manipulators (a.k.a. robots)
- The role of models in control

# On control of industrial manipulators

- Tool position estimation with inertial measurements
  *(presented at LINK-SIC workshop 2017)*
- Comparison of Feedback linearization and Jacobian linearization
  *(presented at LINK-SIC workshop 2018)*

# On the role of models in control

- Procedure for teaching a number of model-related concepts in a unified manner. *(partly presented at LINK-SIC workshop 2019)*
- A definition of control that can be used for emphasizing the role of models.
- Some illustrative block diagram reformulations.

# A definition of control

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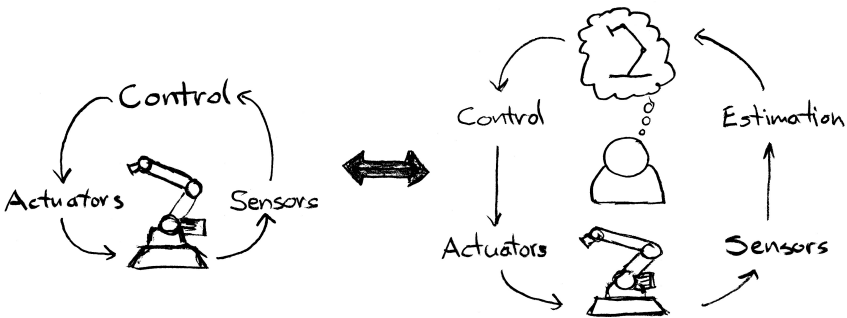


# A definition of control

### Definition (Control)

Performing control means taking motivated action.

### Definition (Motivated action)

An action is motivated if it is based on a *desire*, and on a *belief* of how the action will affect the fulfillment of the desire.[1]

[1] This definition is taken more or less directly from the so called Humean theory of motivation.

# Desire and belief

**Definition (Desire)**

A desire is a combination of a *model* and a *measure of similarity*.

**Definition (Belief)**

A belief is a combination of a *model* and a *degree of confidence*.

# Uses for this model of control

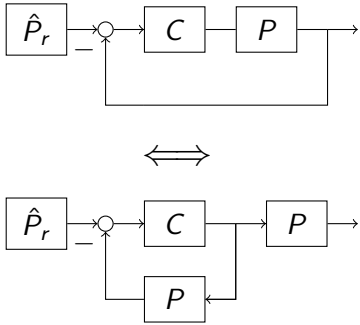
- Emphasize the dual role of models
- Emphasize the human aspect of control engineering

## Some block diagram reformulations

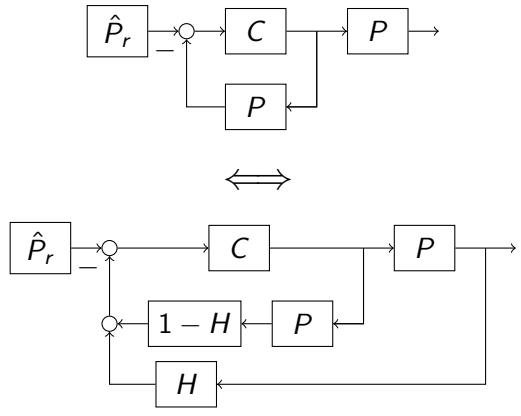
# Some block diagram reformulations

Illustrating the relation between inversion and feedback, and the role of models.

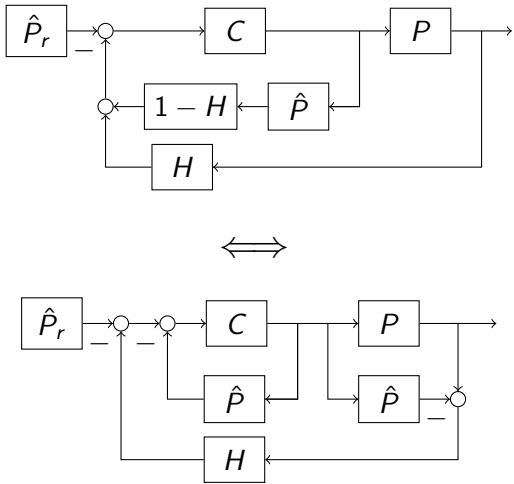
# Inversion by feedback



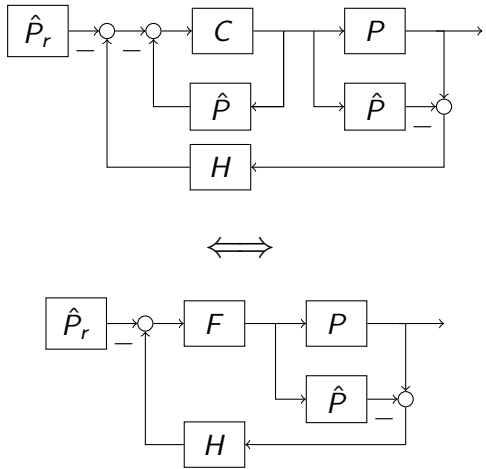
# A hybrid form



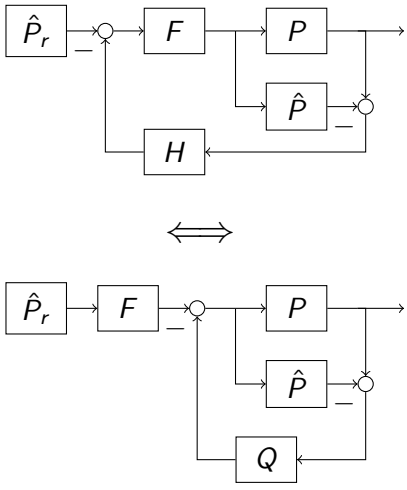
# Complementary filtering



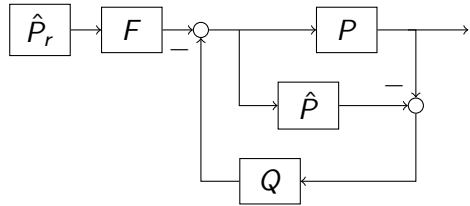
# Rewrite approximate inverse as controller



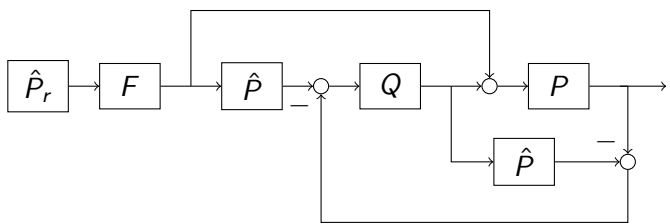
# Arrive at internal model control



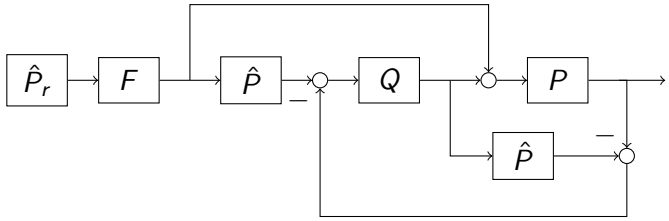
# Separate out feedforward component



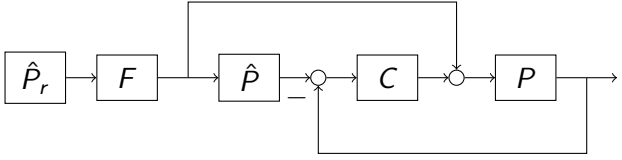

$\Longleftrightarrow$



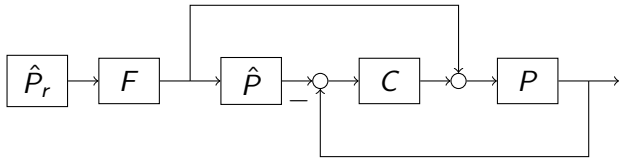
# Rewrite IMC as error feedback




$\Longleftrightarrow$

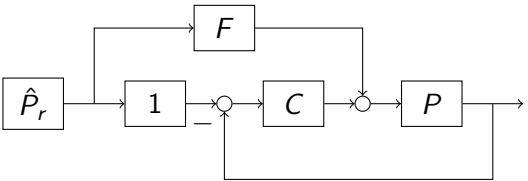


# Approximate the feedforward as perfect




$$F\hat{P} \approx 1$$

$$\Longleftrightarrow$$



Thank you for listening!