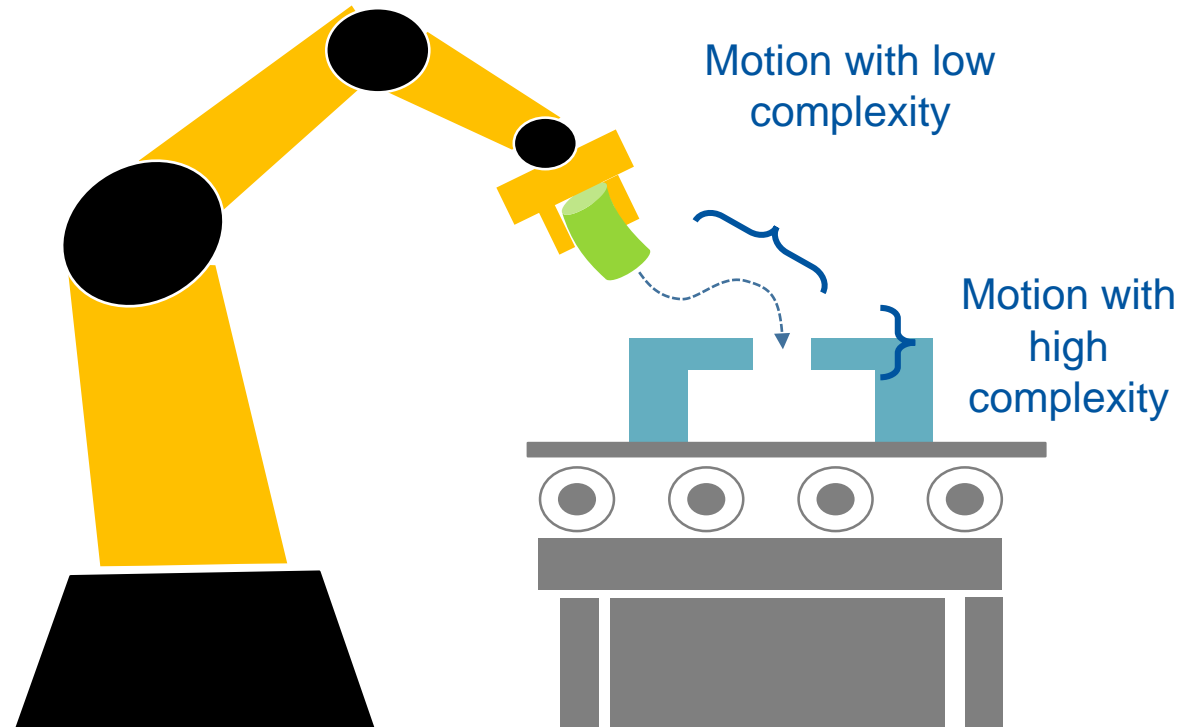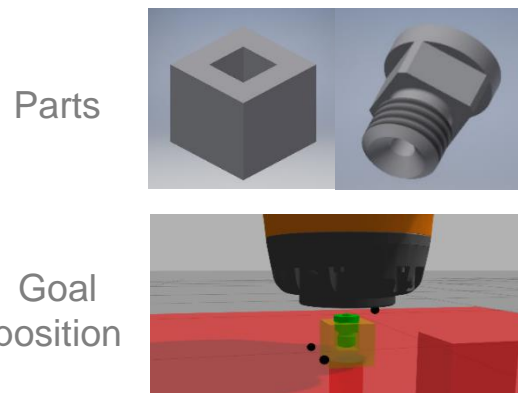# Robotics for Future Industrial Applications

Tuning Cost Functions

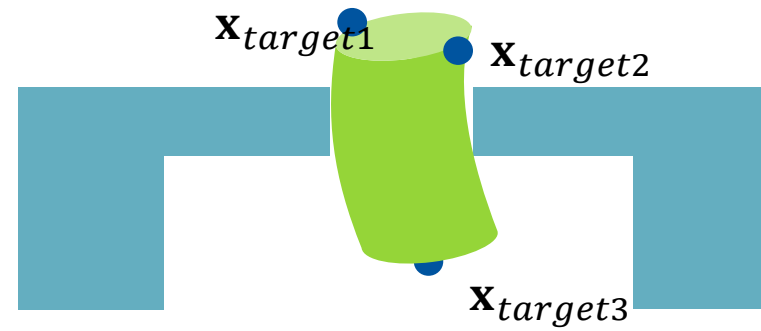Philipp Ennen, M.Sc.

Motor skills for assembly tasks

- Assembly tasks
  - Low joining tolerances (<0,5 mm)
  - Careful joining of parts
  - Wanted collision at the destination
  - Complexity of movement near the target is increased as at the start position
  - Reaching the final target position more important than a cost-effective path

Parts

Goal position

Motion with low complexity

Motion with high complexity

Motor skills for assembly tasks – Goal Description

- Goal description for assembly tasks
  - Minimal torques
  - Minial distance to goal state
  - Reach the final position

state costs

$$J = w_u \sum_0^N l(u_t) + w_x \sum_0^N l(x_t) + w_{xf}\, l_f(x_N)$$

action costs

Final state costs

- Individual weighting of the action costs for each robot joint

- Description of the target position via virtual points at the destination
  - Three points := position and orientation is fixed
  - One point := only position is fixed

$\mathbf{x}_{target1}$ $\mathbf{x}_{target2}$
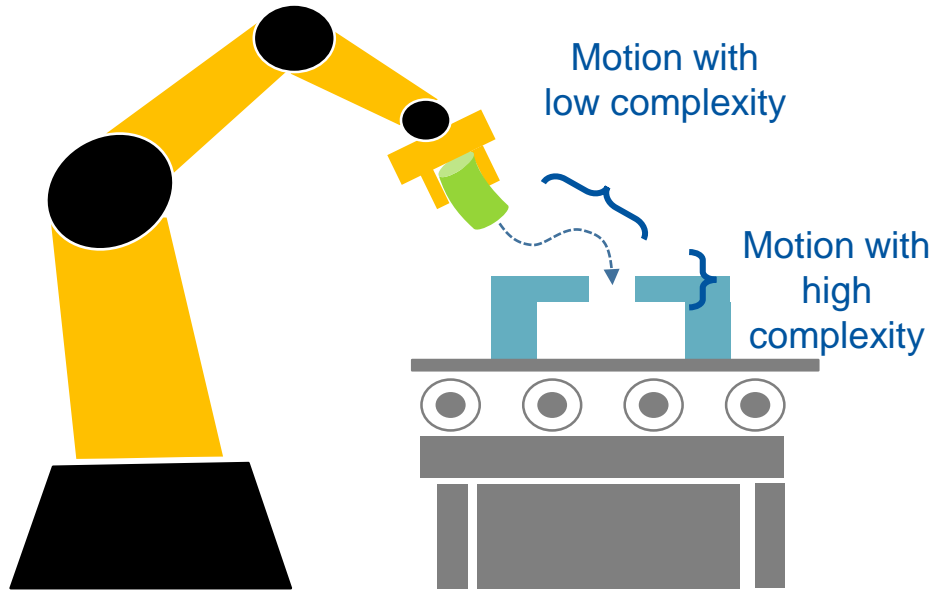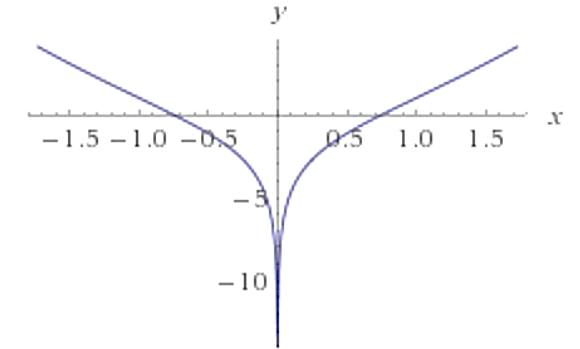
$\mathbf{x}_{target3}$

Motor skills for assembly tasks – Goal Description

- Calculation of state costs via
  - Quadratical term
  - Logarithmic term

> Disproportionate weighting of the distance change in the target range

Motion with low complexity

Motion with high complexity

Quadratical term

$$l(d) = l_1 d^2 + l_2 \log(d^2 + \alpha)$$

Logarithmic term