Software Architecture for Industrial Robots

Kai Friedrich, Dariusz Krolikowski, Jens Meinicke

Agenda

1. Introduction
2. Components
3. Preprocessing
4. Movement
   - 4.1 Point-To-Point
   - 4.2 Linear
5. Summary

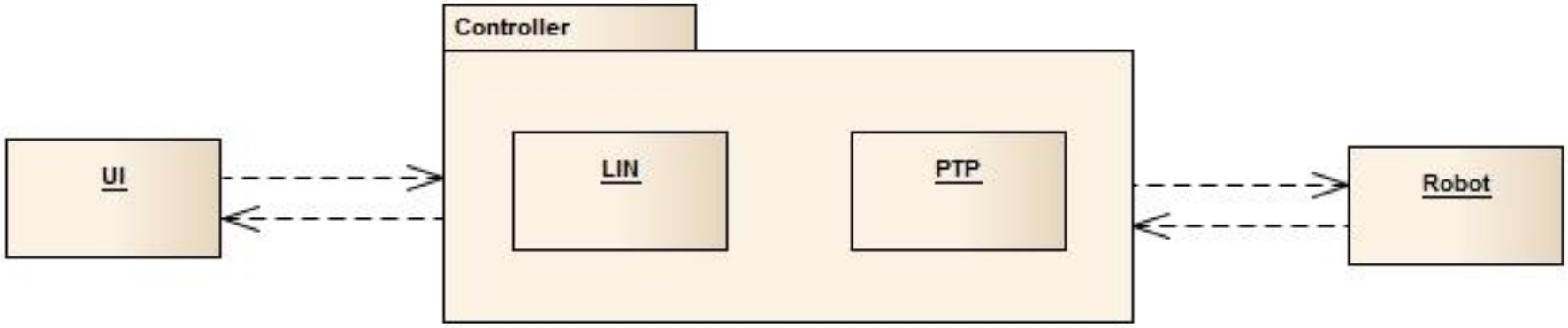
Introduction

- Task:
  - Development of a software architecture for a 6-axis industrial robot with a 3-axis translation stage attached

Introduction

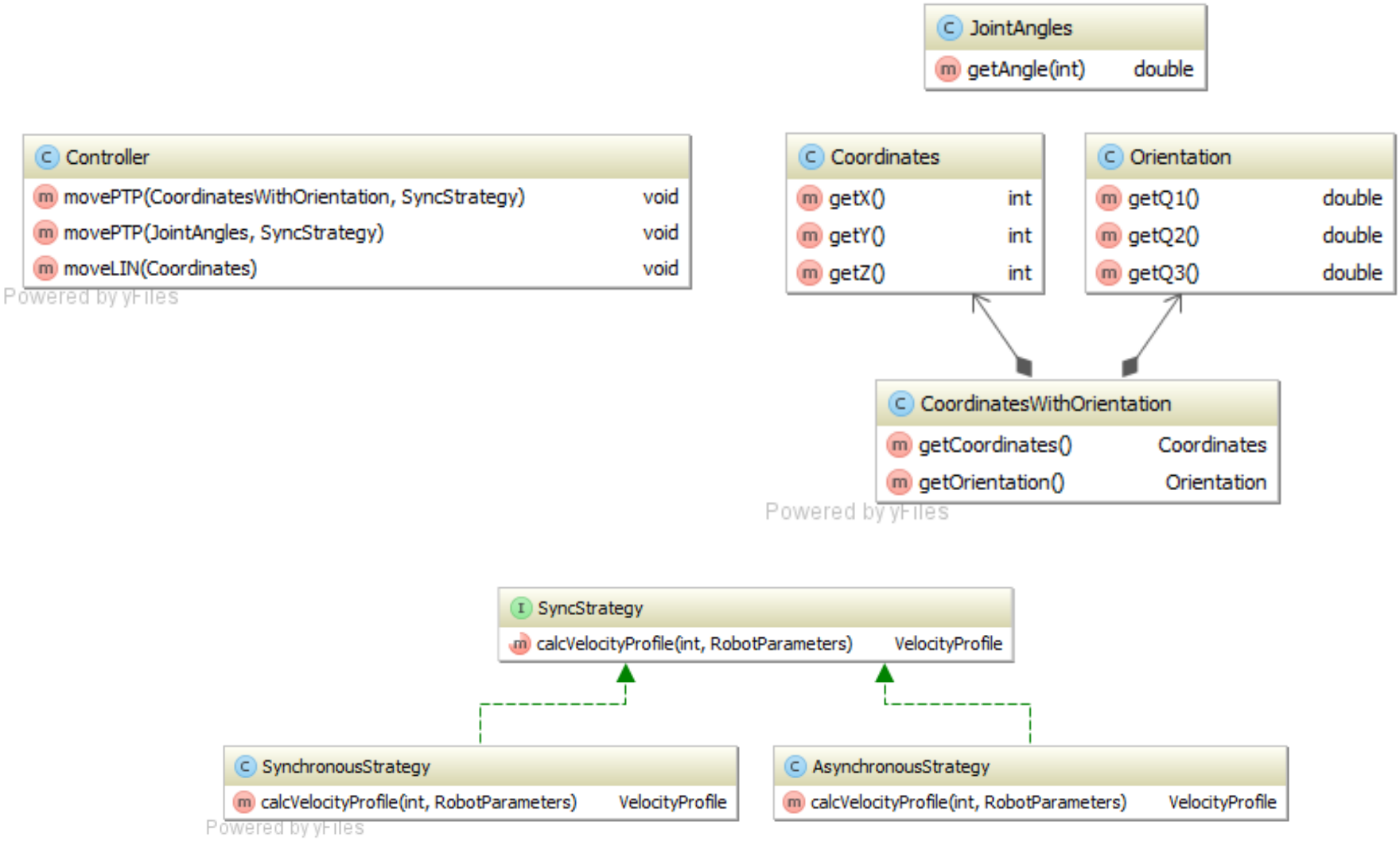
- Challenges:
  - Standardized coordinate systems
  - Layouts of robot
  - Positioning of the wrist
  - Orientation of the wrist
  - Computation of trajectories
  - Computation of velocity profiles
  - Selection of solution
  - Handling of singularities

Component Overview

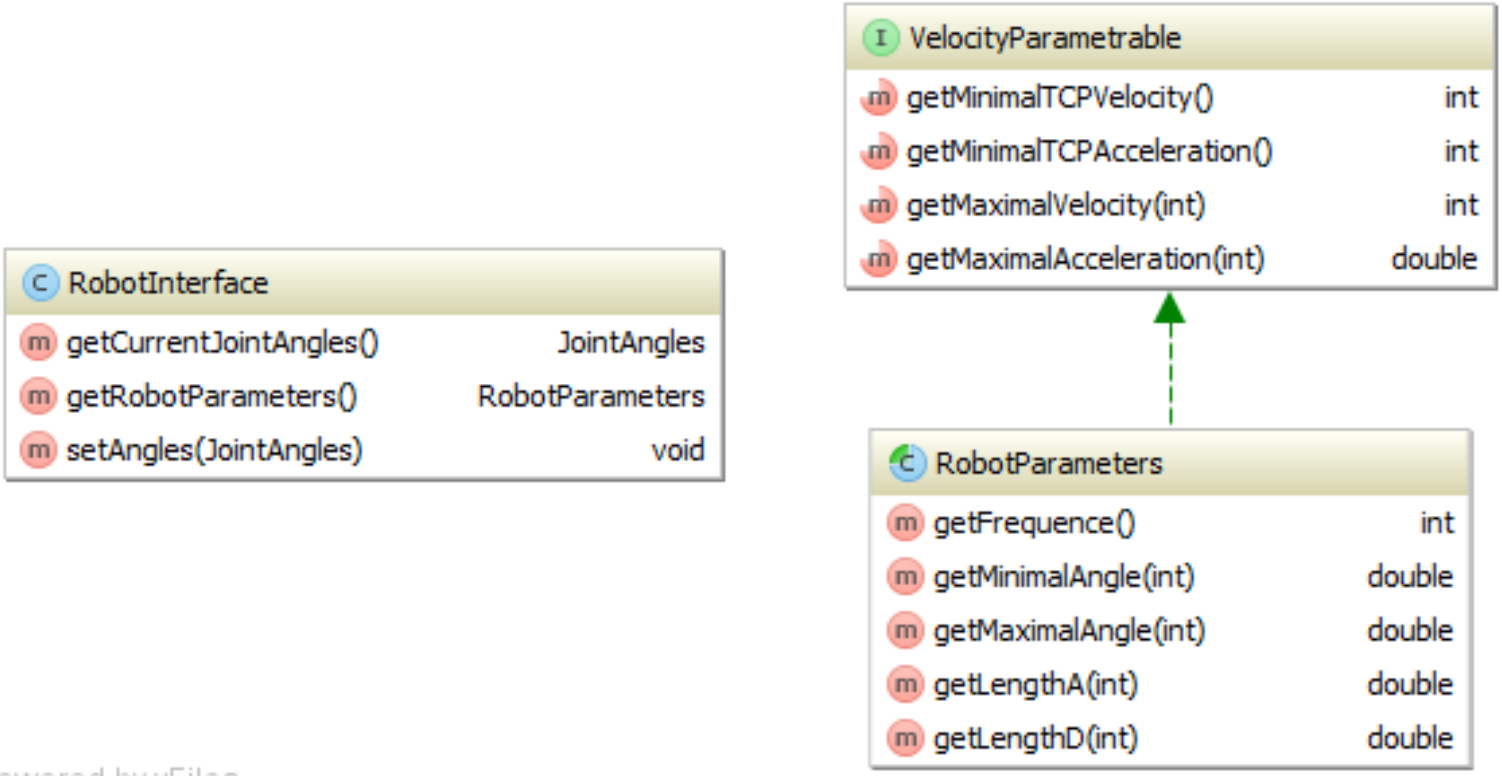


- Commands:
  - Catesian- & Joint-space
  - LIN & PTP Movements
  - Synchronuous & asynchronuous movements

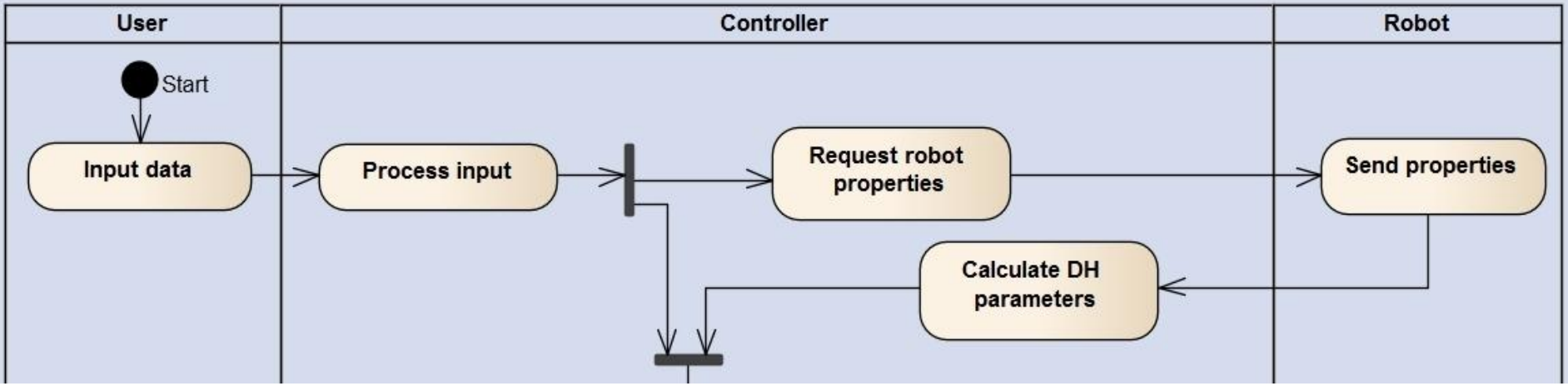
Component Overview

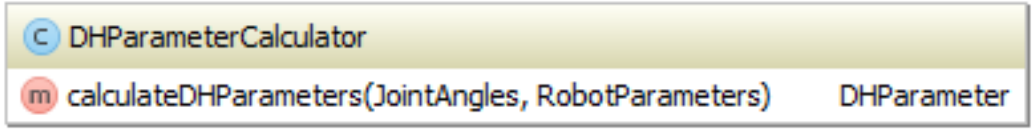


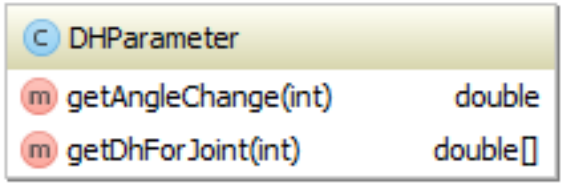
Robot Interface



Preprocessing 1

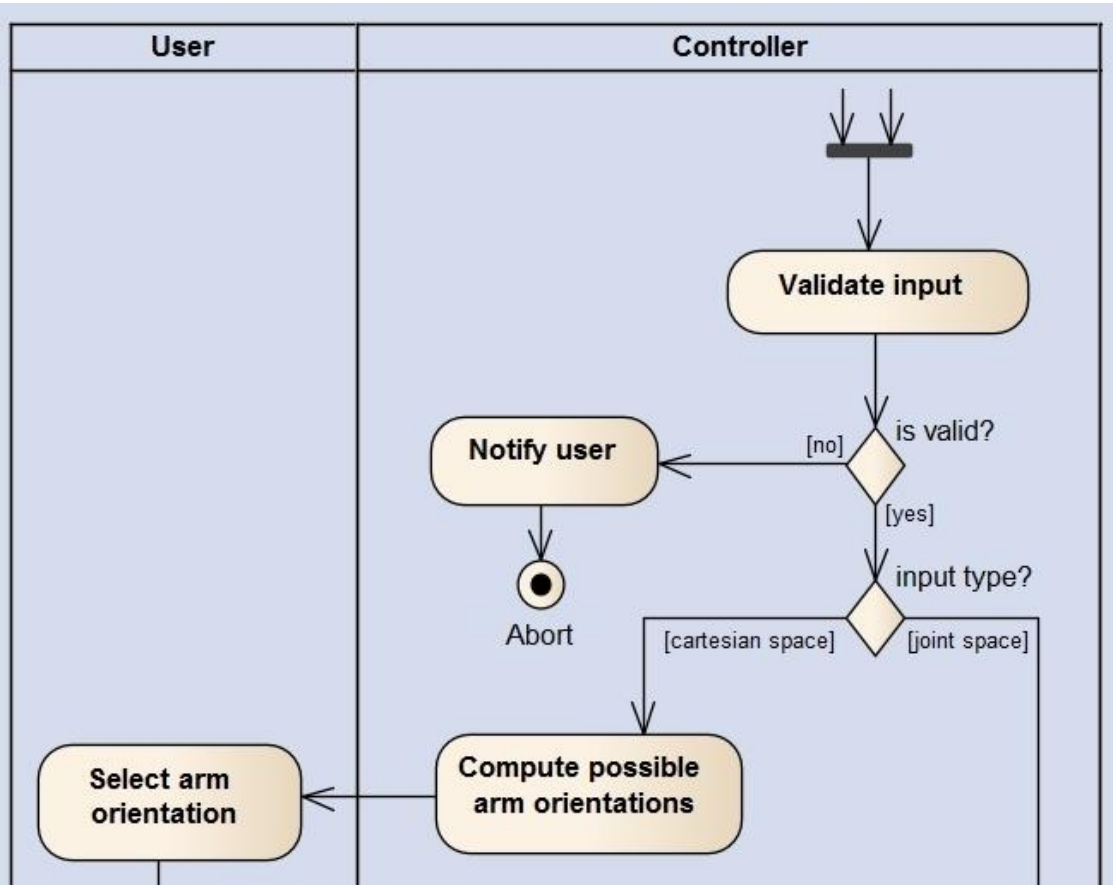


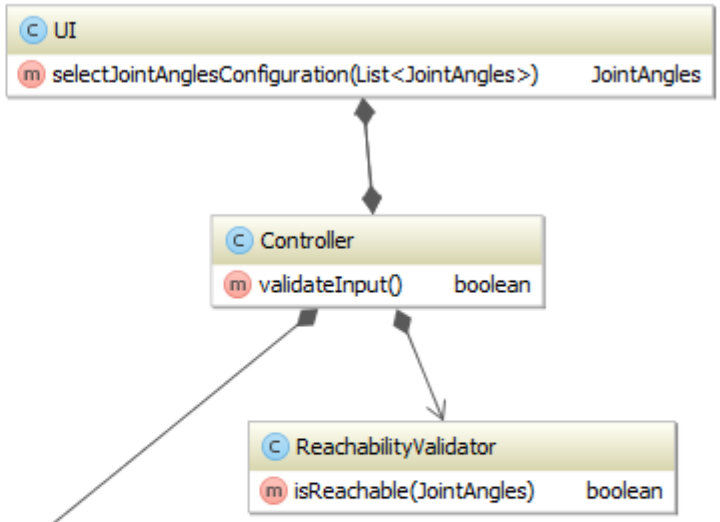


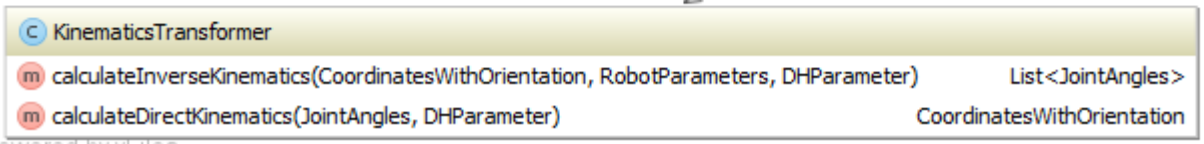


	a	d	θ	α
0	0	0	$\pi/2$	π
1	0	0	Θ_1	-π
2	0.350000	-0.815000	Θ_2	$-\pi/2$

Preprocessing 2

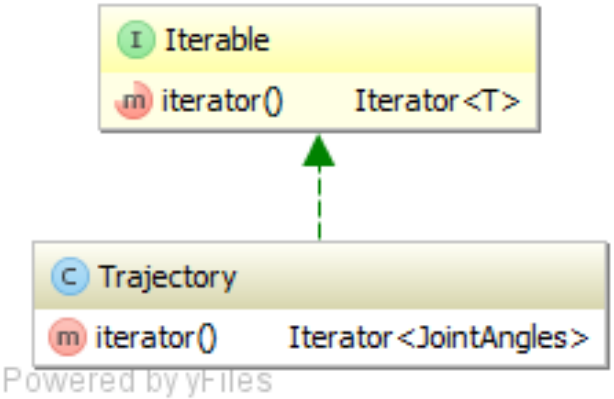


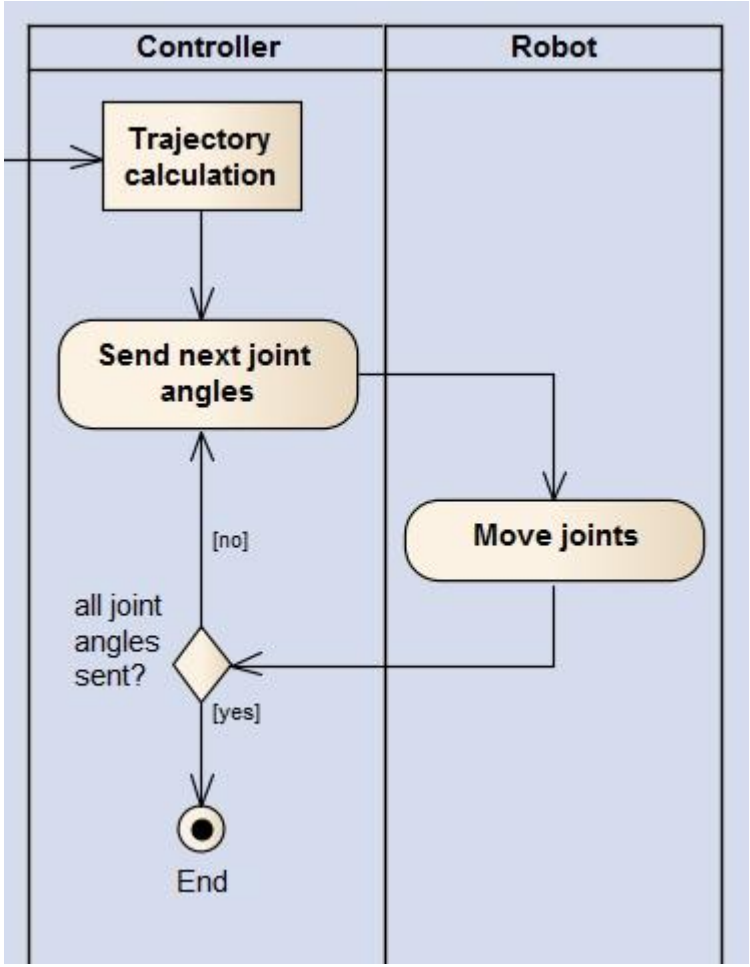




Movement

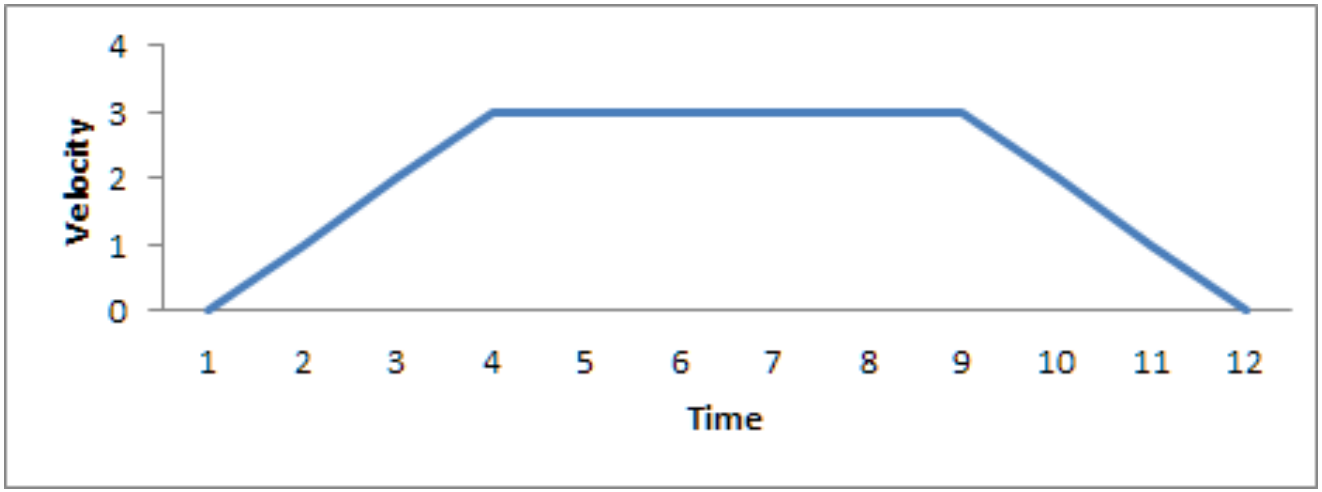
- Different aproaches for PTP and LIN
- Motion planning components return a trajectory
- Sequence of joint angles
- Clocked by robot‘s frequency





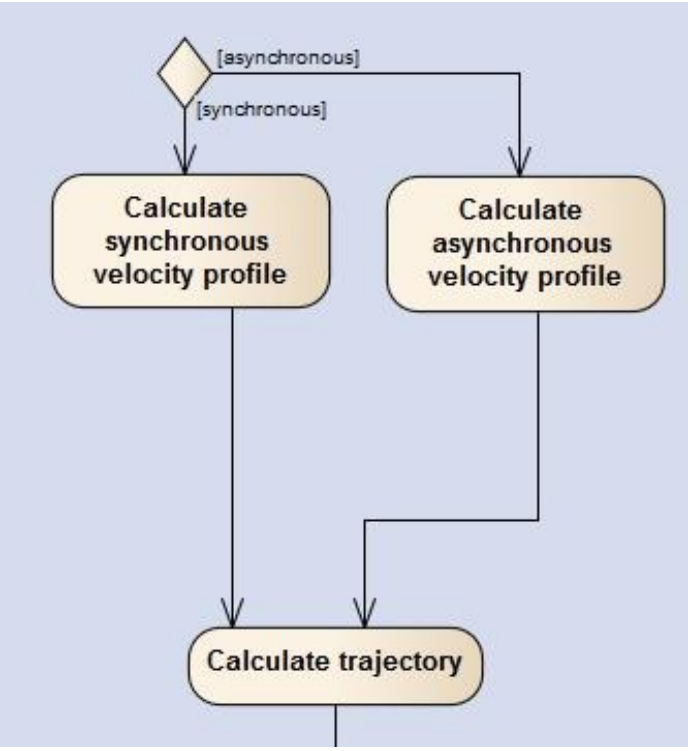
Velocity Profiles

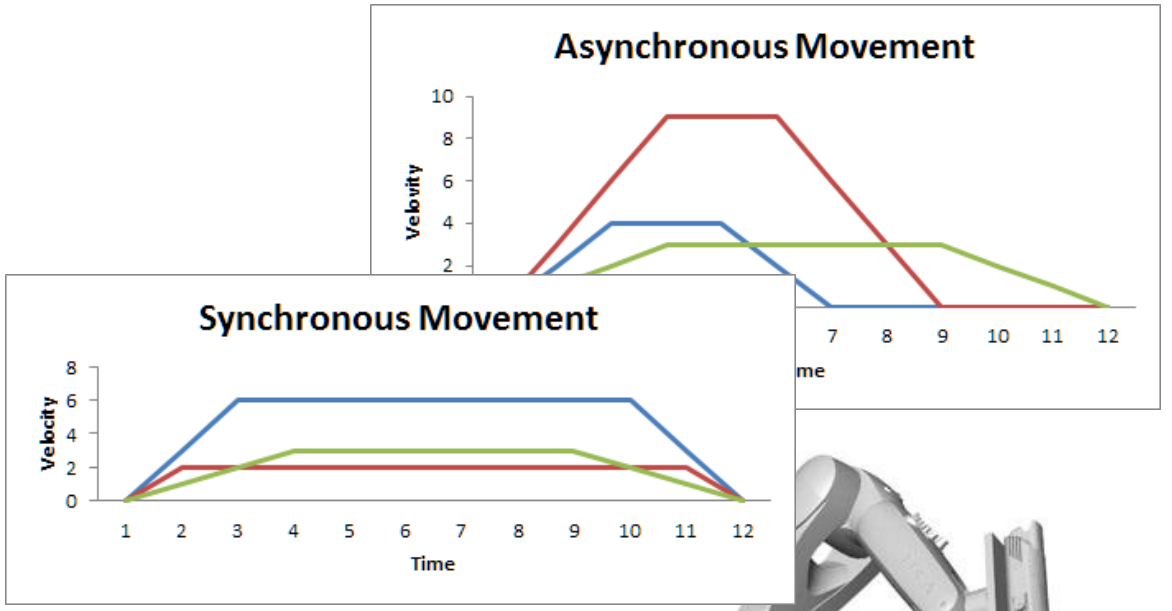
- Constant acceleration
- Constant maximal velocity
- Total time

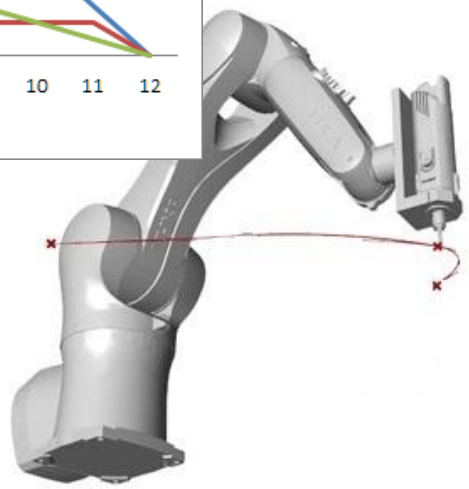


Point-To-Point Motion Planning

- Motion planning in joint spcae



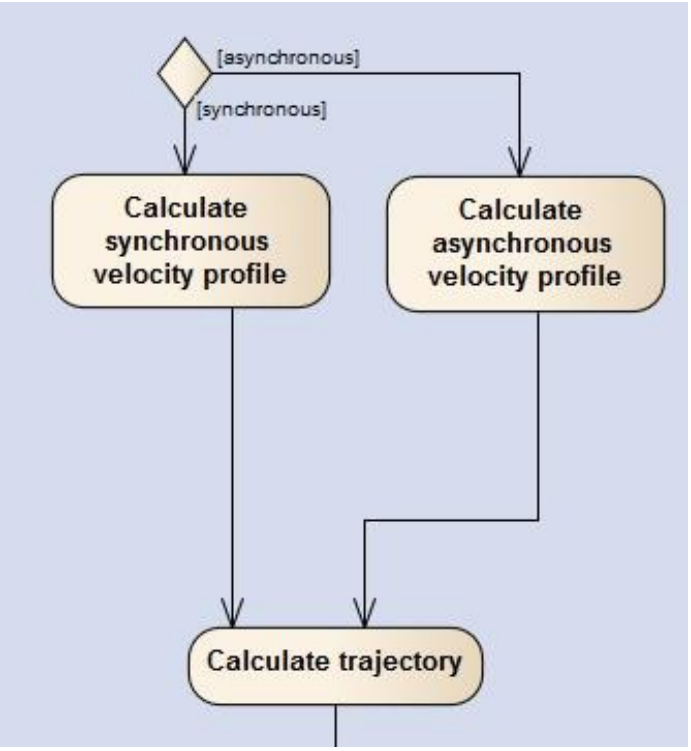


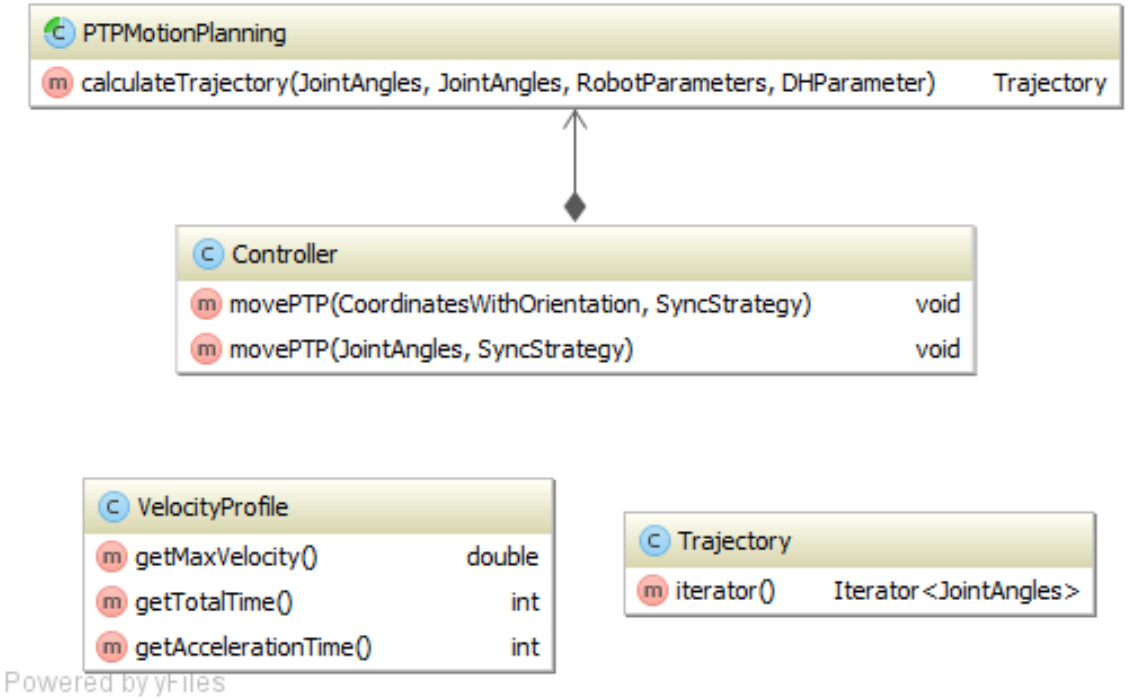


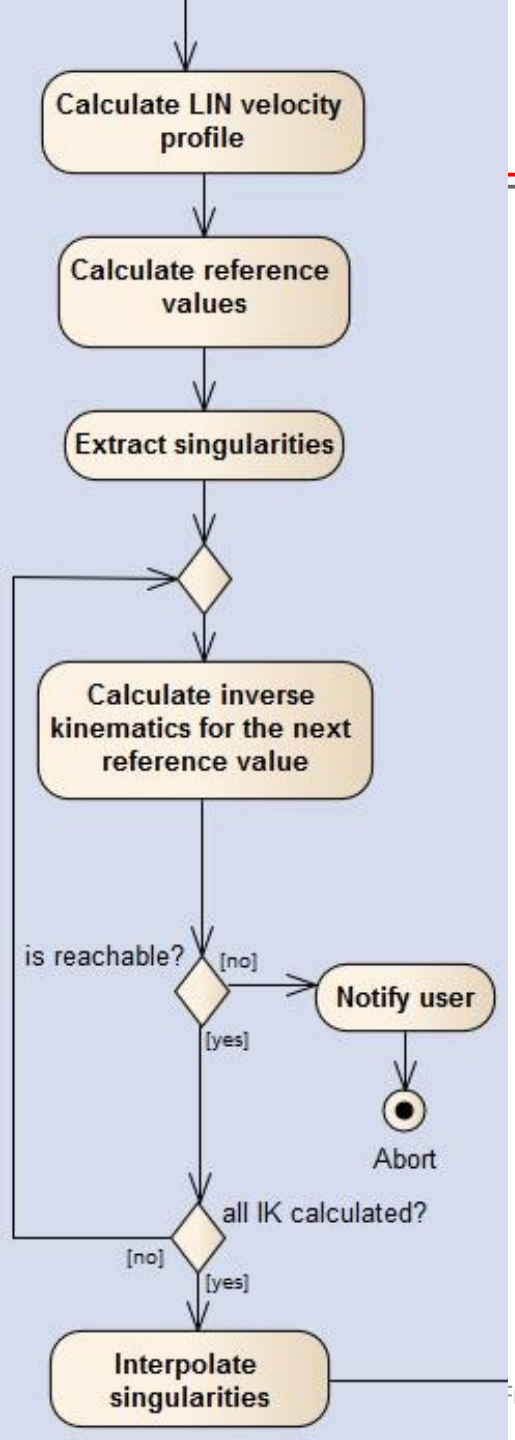
http://forum.robotsinarchitecture.org/index.php/topic,24.0.html

Point-To-Point Motion Planning

- Motion planning in joint spcae

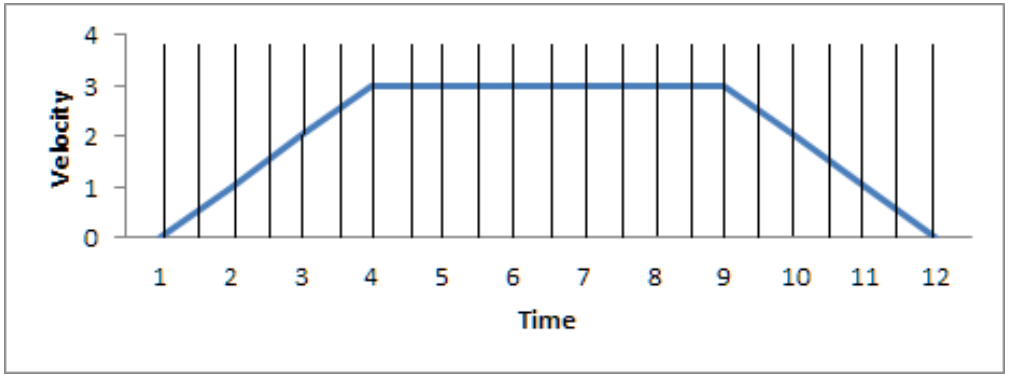


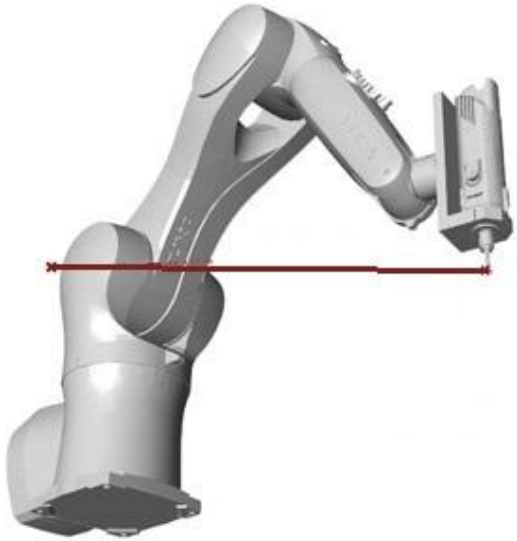




Linear Motion Planning

- Motion planning in Cartesian space





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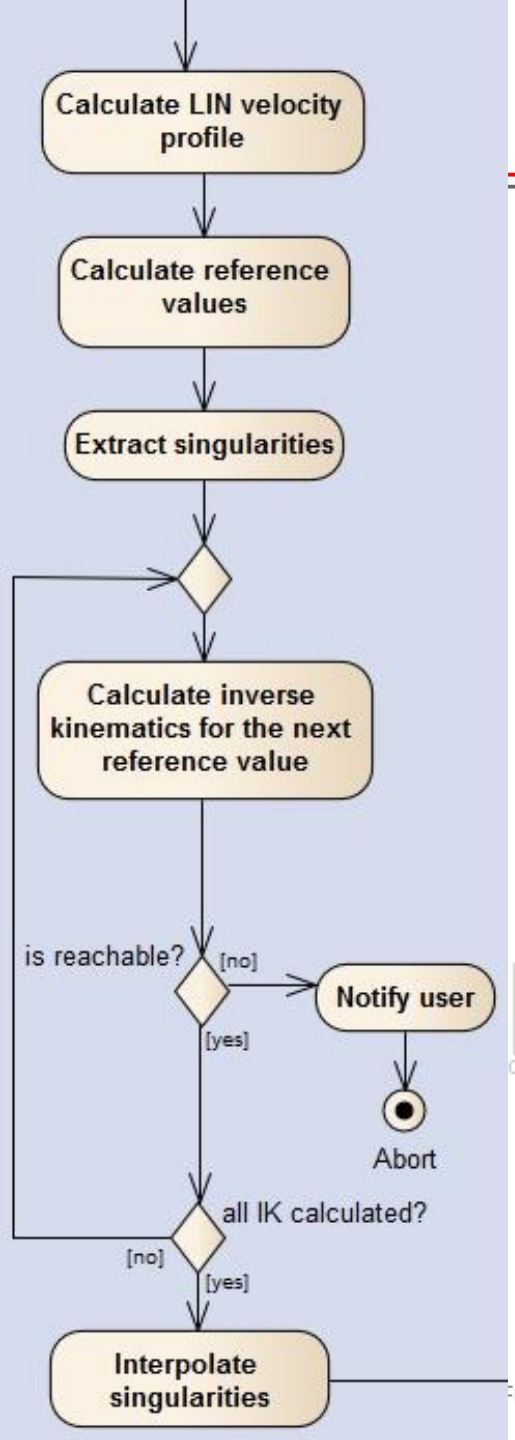
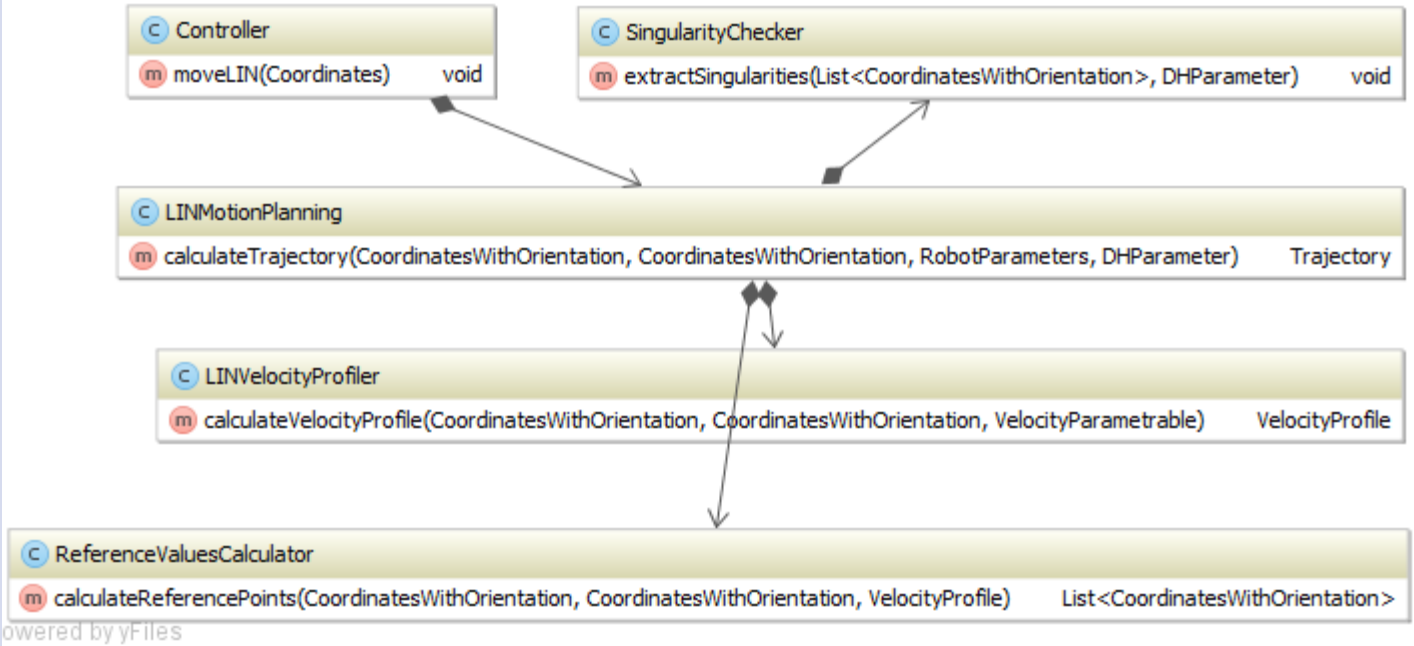
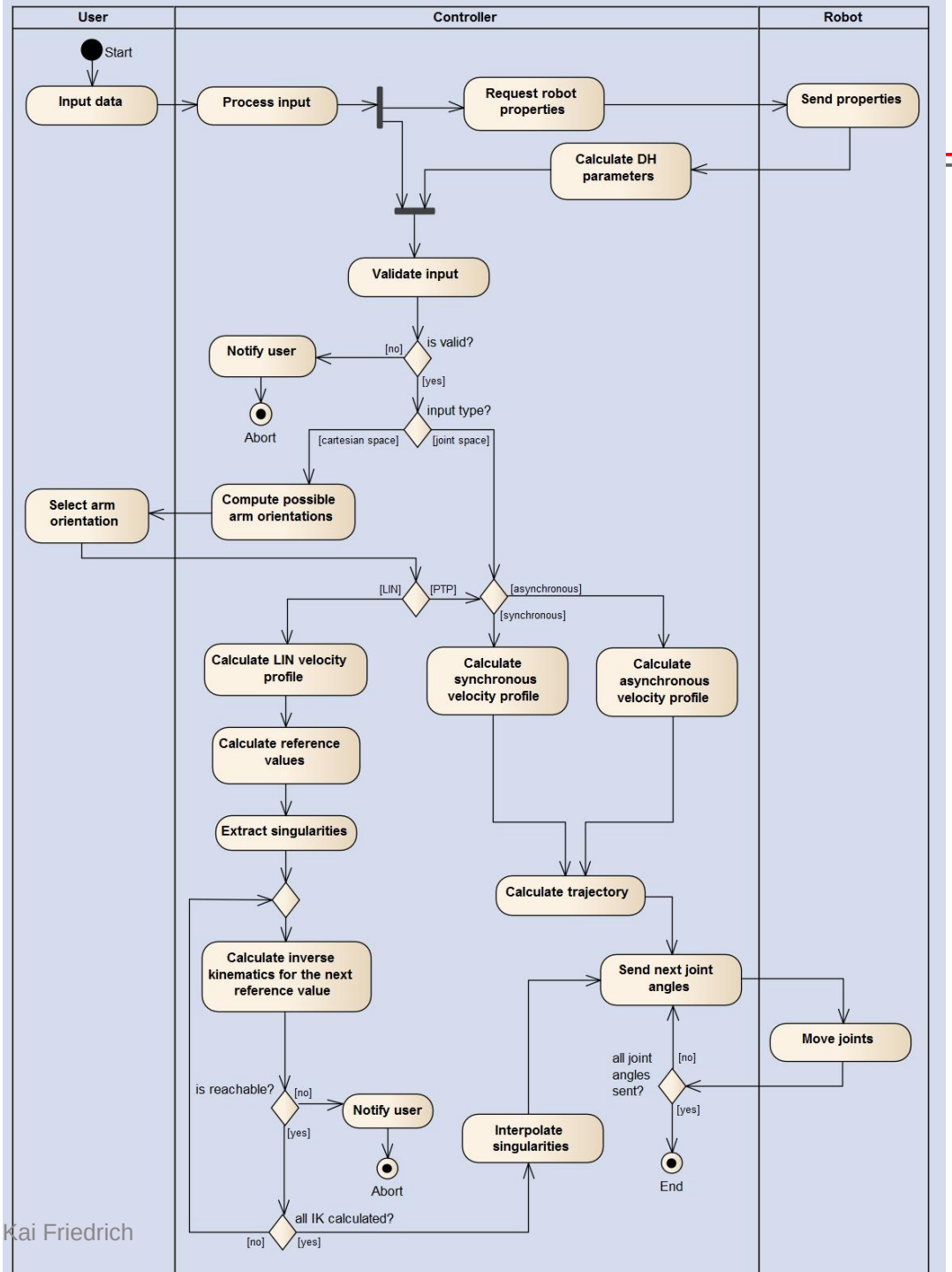
Linear Motion Planning






User
Controller
Robot
Start
Input data
Process input
Request robot properties
Send properties
Calculate DH parameters
Validate input
is valid?
[no]
[yes]
Notify user
Abort
input type?
[cartesian space]
[joint space]
Compute possible arm orientations
Select arm orientation
[LIN]
[PTP]
[asynchronous]
[synchronous]
Calculate LIN velocity profile
Calculate synchronous velocity profile
Calculate asynchronous velocity profile
Calculate reference values
Extract singularities
Calculate trajectory
Calculate inverse kinematics for the next reference value
Send next joint angles
Move joints
is reachable?
[no]
[yes]
Notify user
Abort
all joint angles sent?
[no]
[yes]
End
Interpolate singularities
all IK calculated?
[no]
[yes]

Thanks for your attention!