

When two arms get close and kiss

Inverse kinematics for the RoFI platform

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Motivation

1. “Hand me a coffee”
 - static arm reaching towards a specified position (and rotation)
2. Connection of two arms
 - a step towards an effective reconfiguration algorithm

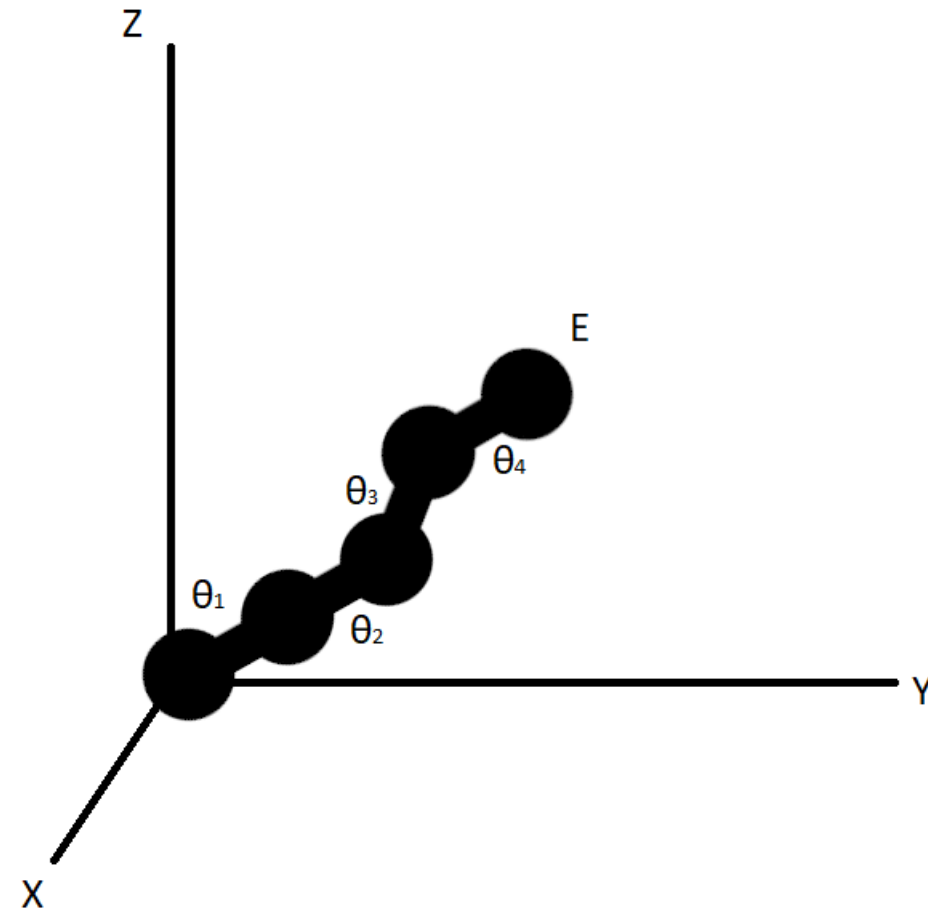
Kinematics

1. Forward kinematics

$$E = f(\theta)$$

2. Inverse kinematics

$$\theta = f^{-1}(E)$$



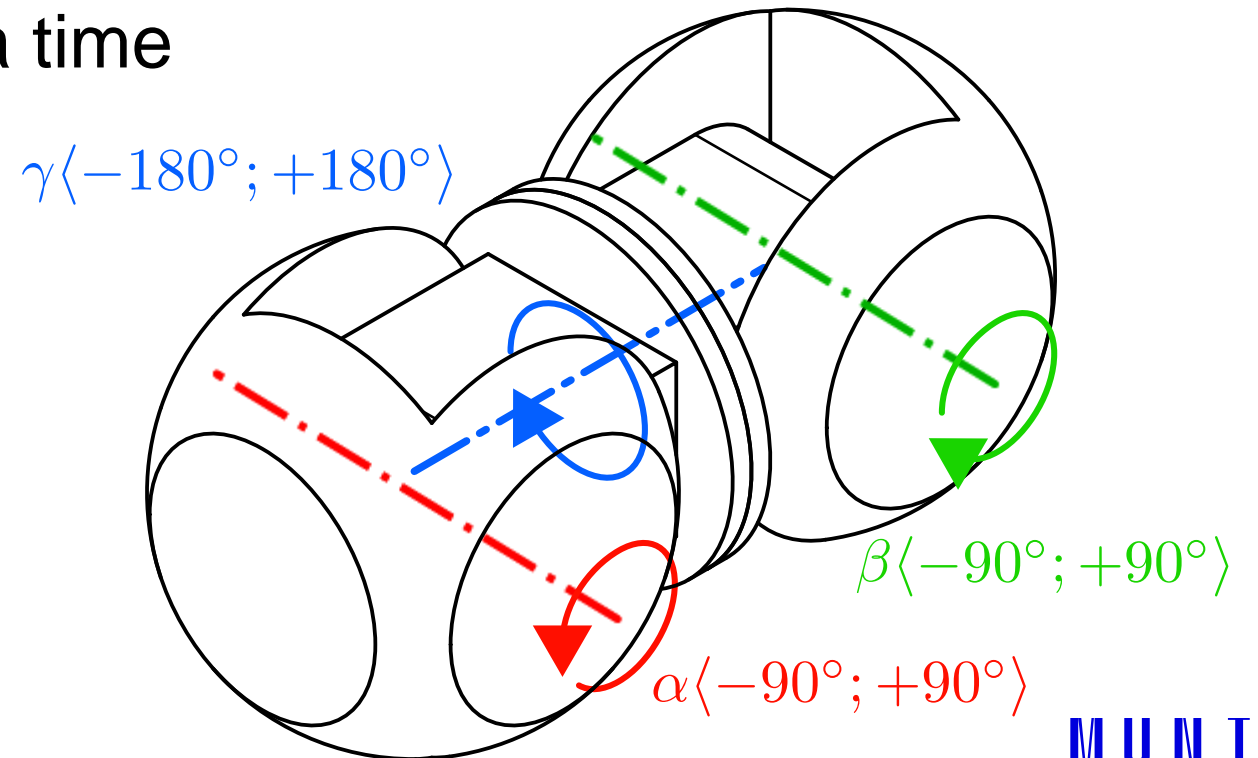
Requirements for the algorithm

1. Reliability
2. Effectivity
3. Scalability
4. Simplicity

Limitations

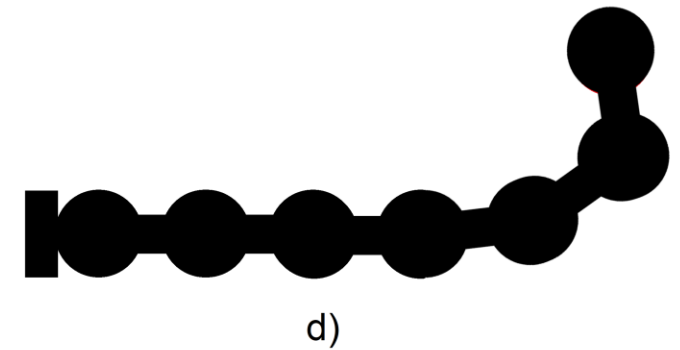
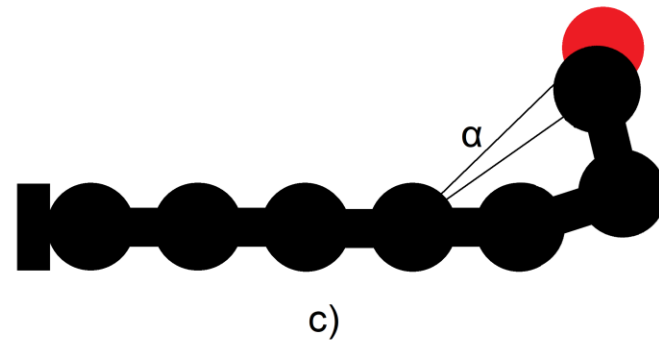
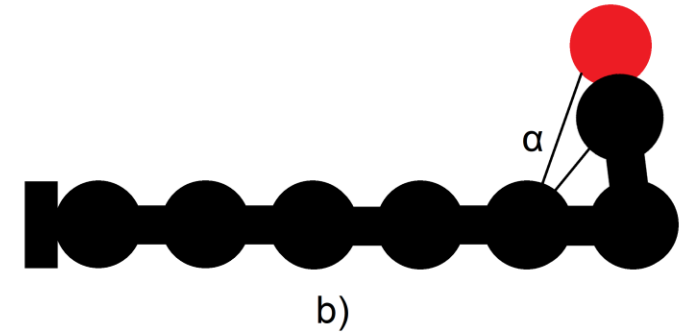
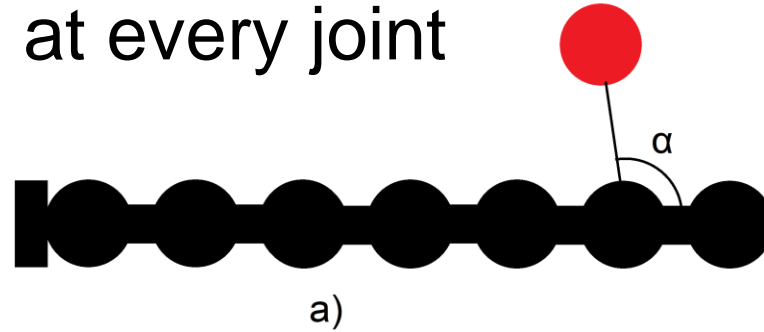
Unique RoFI module

1. A, B limited to $(-90^\circ, 90^\circ)$
2. rotation around one joint at a time

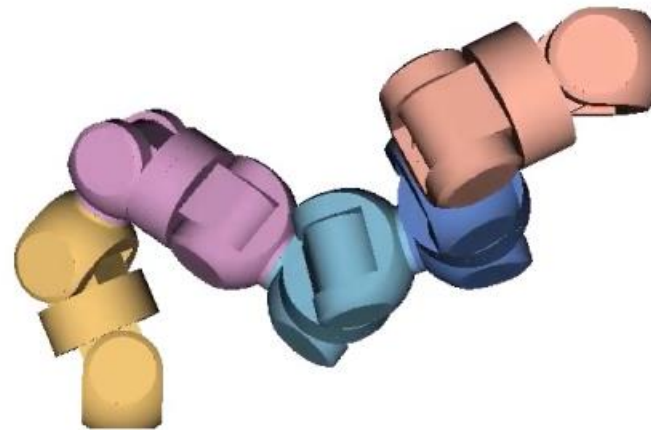


Cyclic Coordinate Descent - CCD

Minimizes distance at every joint

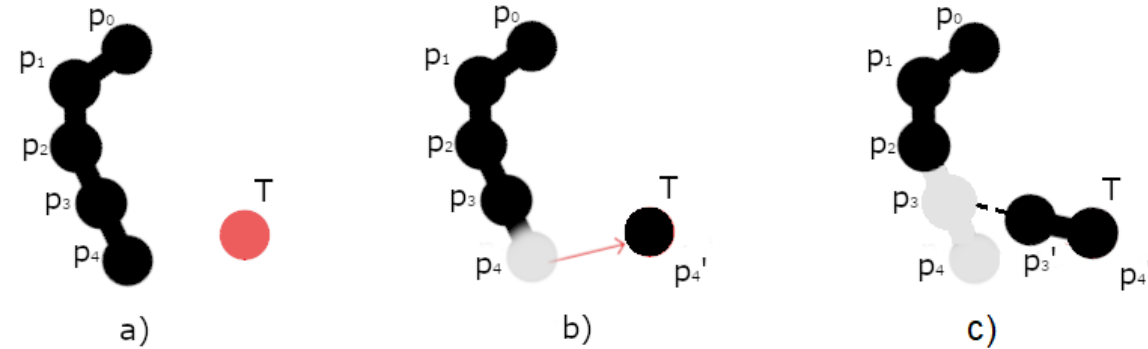


CCD

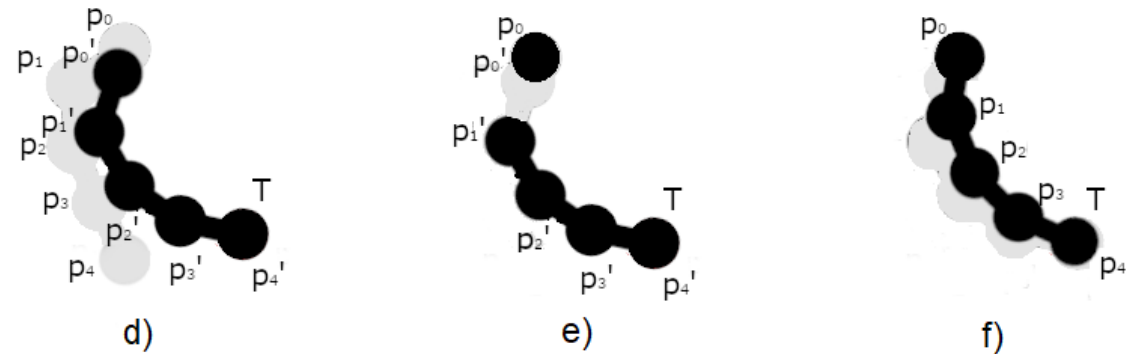


FABRIK

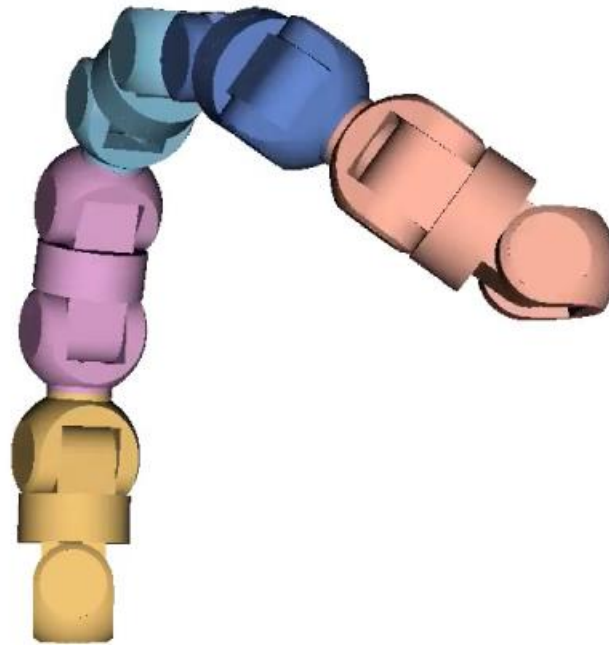
1. Forward reaching



2. Backward reaching



FABRIK



Jacobian Pseudoinverse

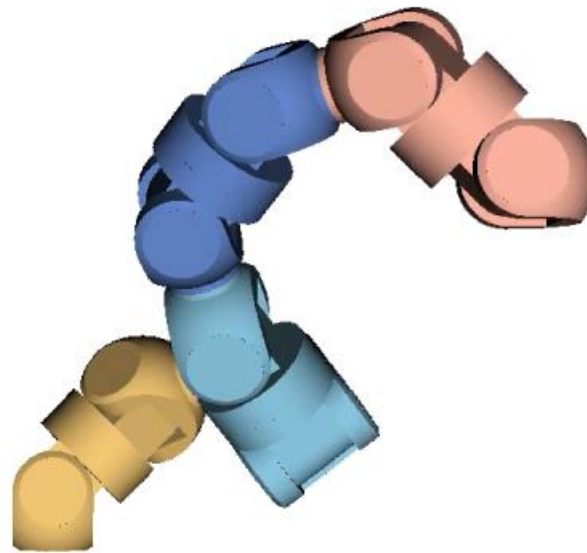
Jacobian matrix reflects configuration changes on the end-effector

– $dE = J(\theta)d\theta$

Inverting this matrix gives us an IK solution

– $d\theta = J(\theta)^{-1}dE$

JP



Connecting two arms



THE ROV
PLATFORM

Future considerations

- Implementing the algorithms on real hardware:
 - Limited computational strength
 - Limited joint strength
 - Collision avoidance

Conclusion

- Solving inverse kinematics:
how to reach a specified target with an arm
- Exploring various IK solutions
- Implementing suitable solutions within the RoFI platform
- In the future: dealing with real life obstacles