Going **beyond the limitations** of three and four joints per segments. **Customize the joint location** to your needs and **reuse all previous methods.**

Session AA-4

Paper ID 22

Clarke Transform and Encoder-Decoder Architecture for Arbitrary Joints Locations in Displacement-Actuated Continuum Robots

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Motivation

- current joint configuration
  - limited to $n = 3$ and $n = 4$
  - symmetric
- desired joint configuration
  - task specific

Approach

- use Clarke Transform
- exploit shared 2-dof manifold
  - Clarke coordinates
  - map onto manifold, map back to joint space
  - encoder-decoder architecture

Results

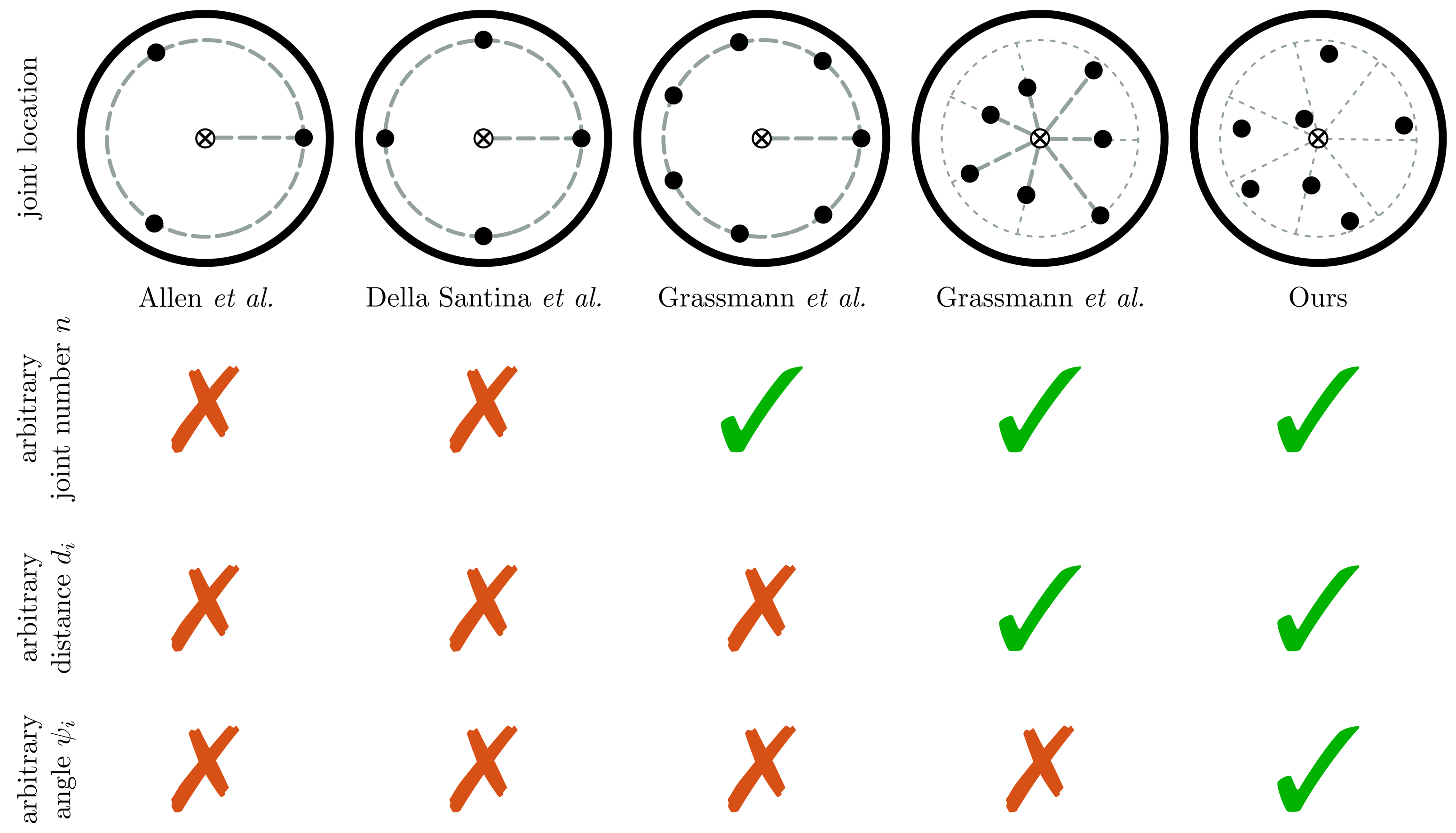
- arbitrary joint location
  - from any to specific
- form surrogate robot to specific robot
- solution is linear and exact

$$\rho_{\text{(robot B)}} = \overbrace{l_{\text{(robot B)}} \operatorname{diag}\left(d_{i,\text{(robot B)}}\right) M^{-1}_{\mathcal{P}\,\text{(robot B)}}}^{\text{adds design parameters of robot B}} \cdot \underbrace{\frac{1}{l_{\text{(robot A)}}} M_{\mathcal{P}\,\text{(robot A)}} \operatorname{diag}\left(\frac{1}{d_{i,\text{(robot A)}}}\right)}_{\text{removes design parameters of robot A}} \rho_{\text{(robot A)}}$$

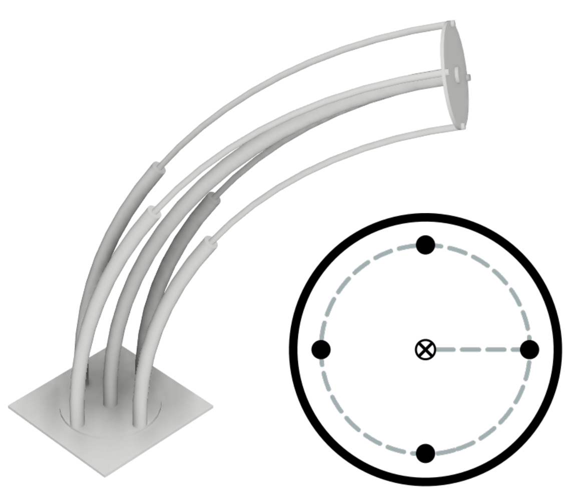
- application: sampling, control, mechanics...

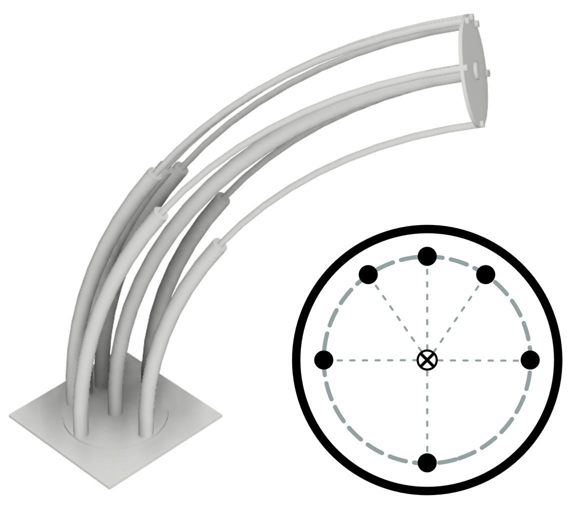
Conclusion

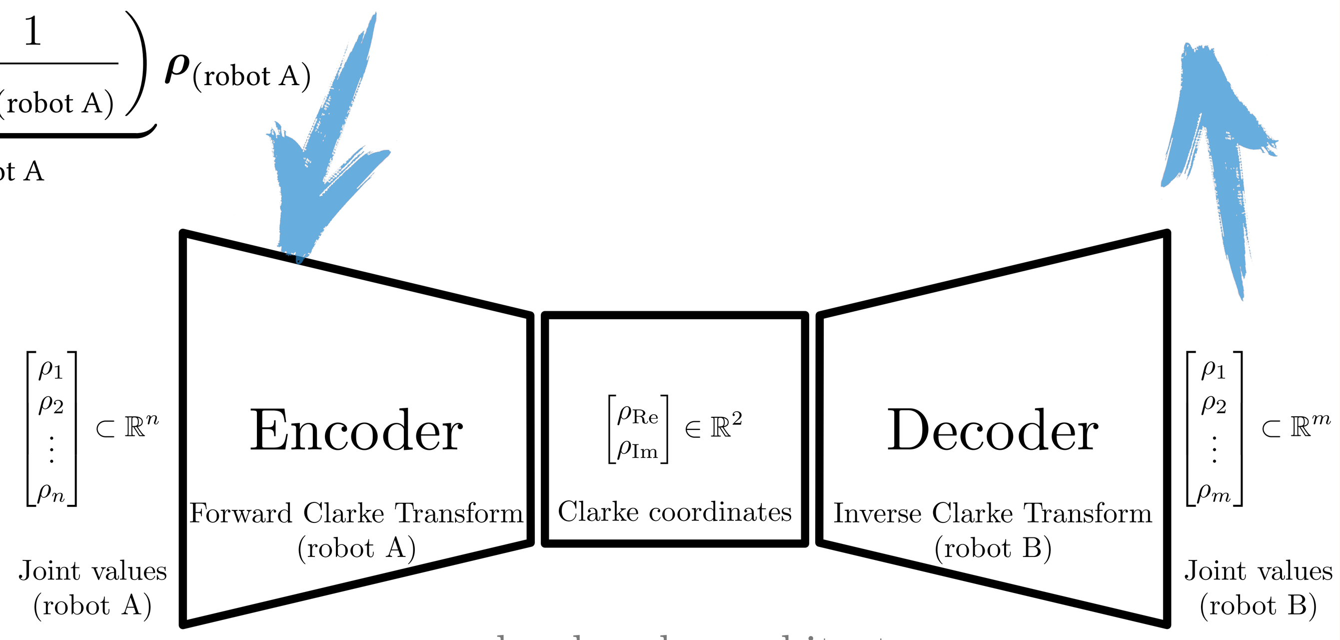
- overcome limitation
- new possibilities
  - algorithmic
  - mechanical design



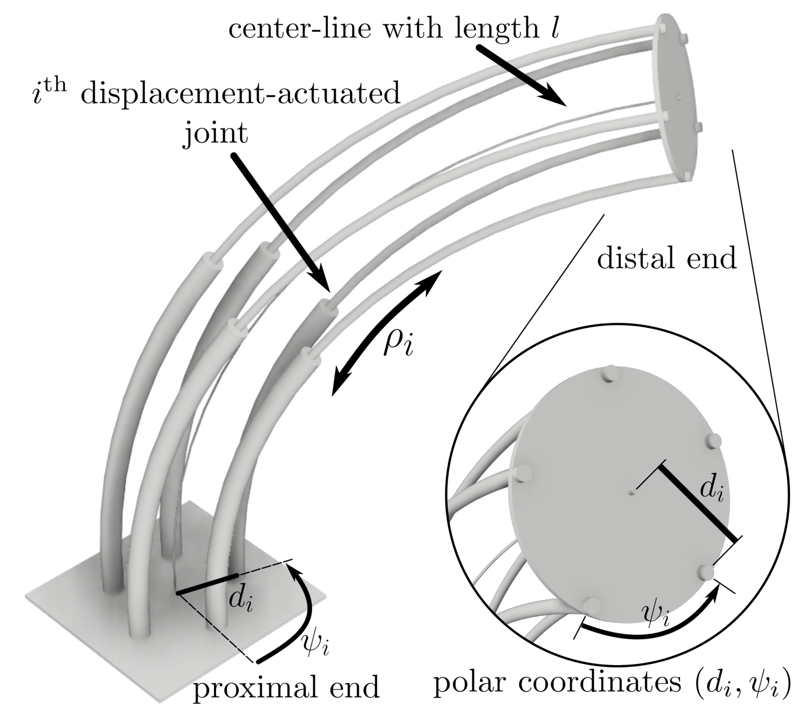
	Allen et al.	Della Santina et al.	Grassmann et al.	Grassmann et al.	Ours
arbitrary joint number n	✗	✗	✓	✓	✓
arbitrary distance d_i	✗	✗	✗	✓	✓
arbitrary angle ψ_i	✗	✗	✗	✗	✓


surrogate robot (robot A)

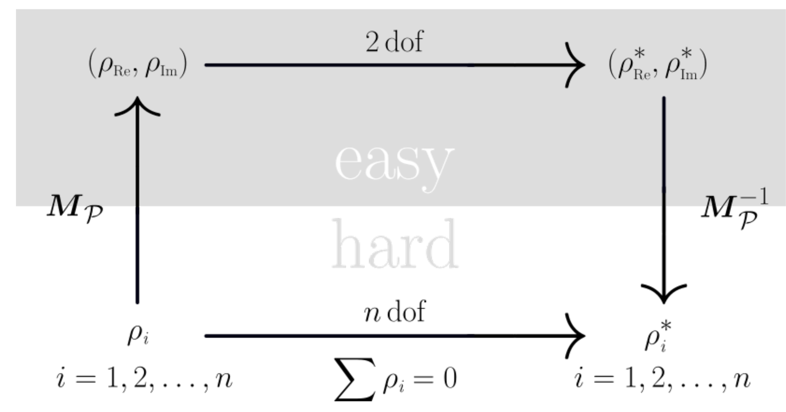

target robot (robot B)



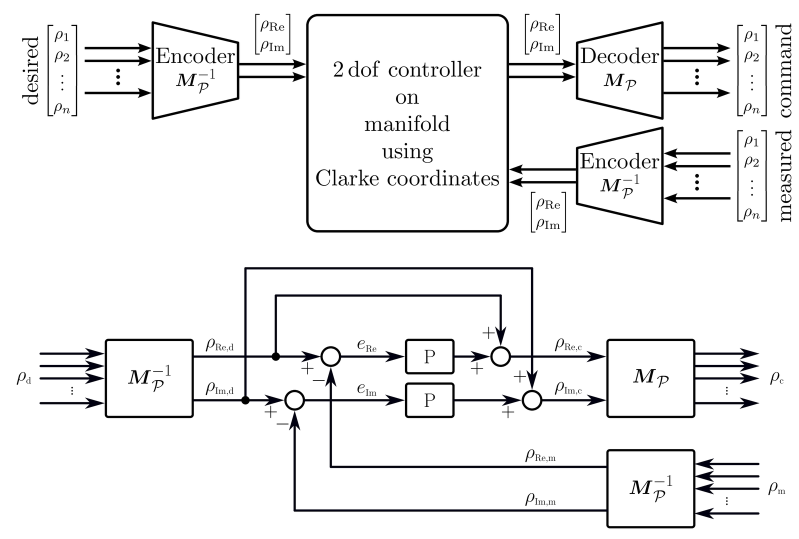
encoder-decoder architecture



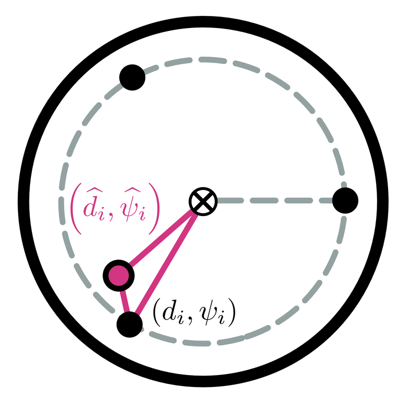
displacement-actuated continuum robot



Clarke Transform and Clarke coordinates



Controller


uncertainty of a joint location

Poster design inspired by Mike Morrison

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