ATSG & FMTN

Continuum/Flexible, Miniaturized Robots for Medical Applications

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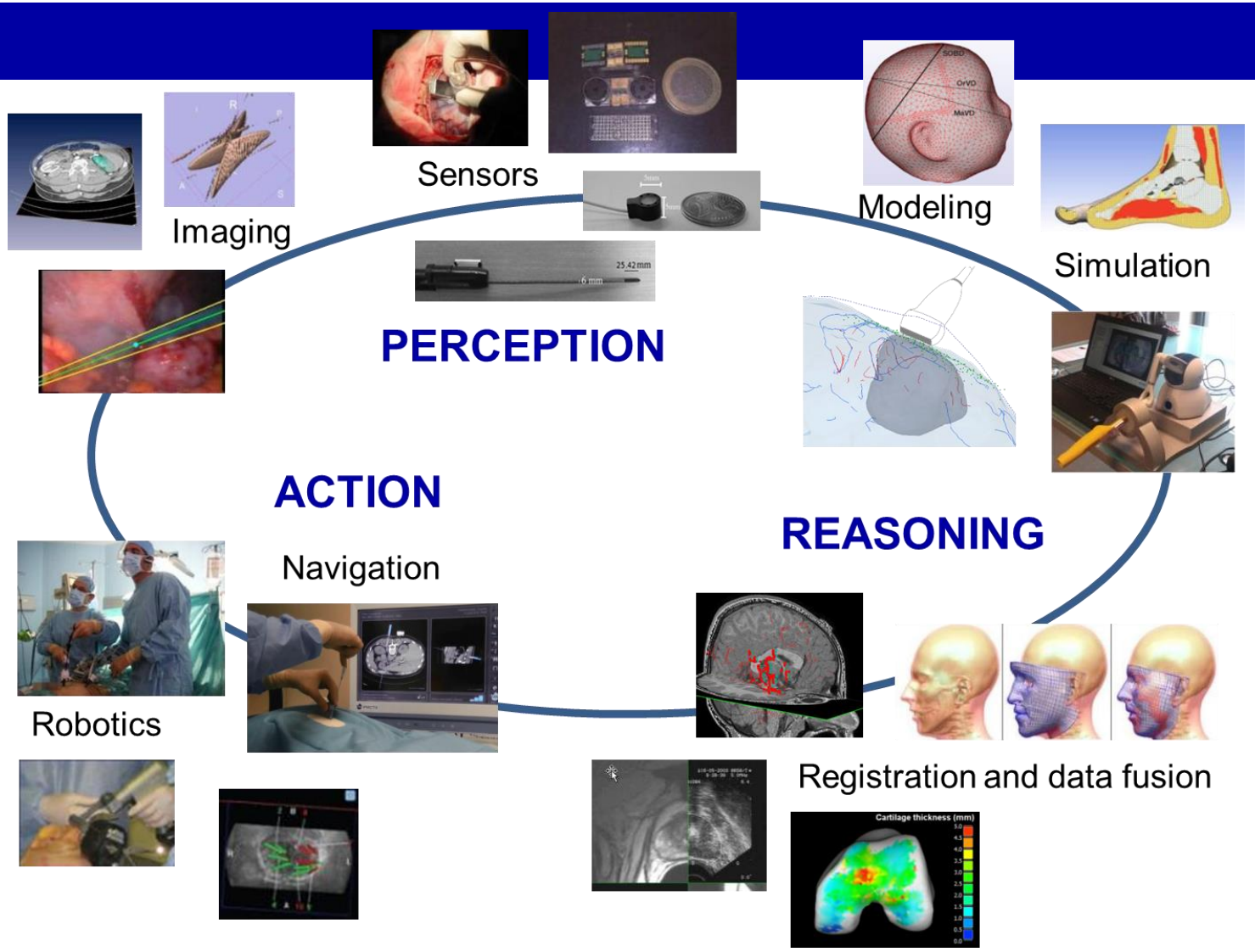
CAMI Team

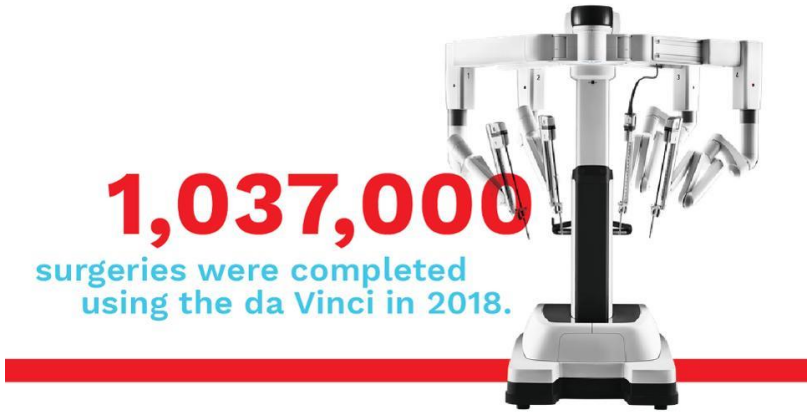
Overview

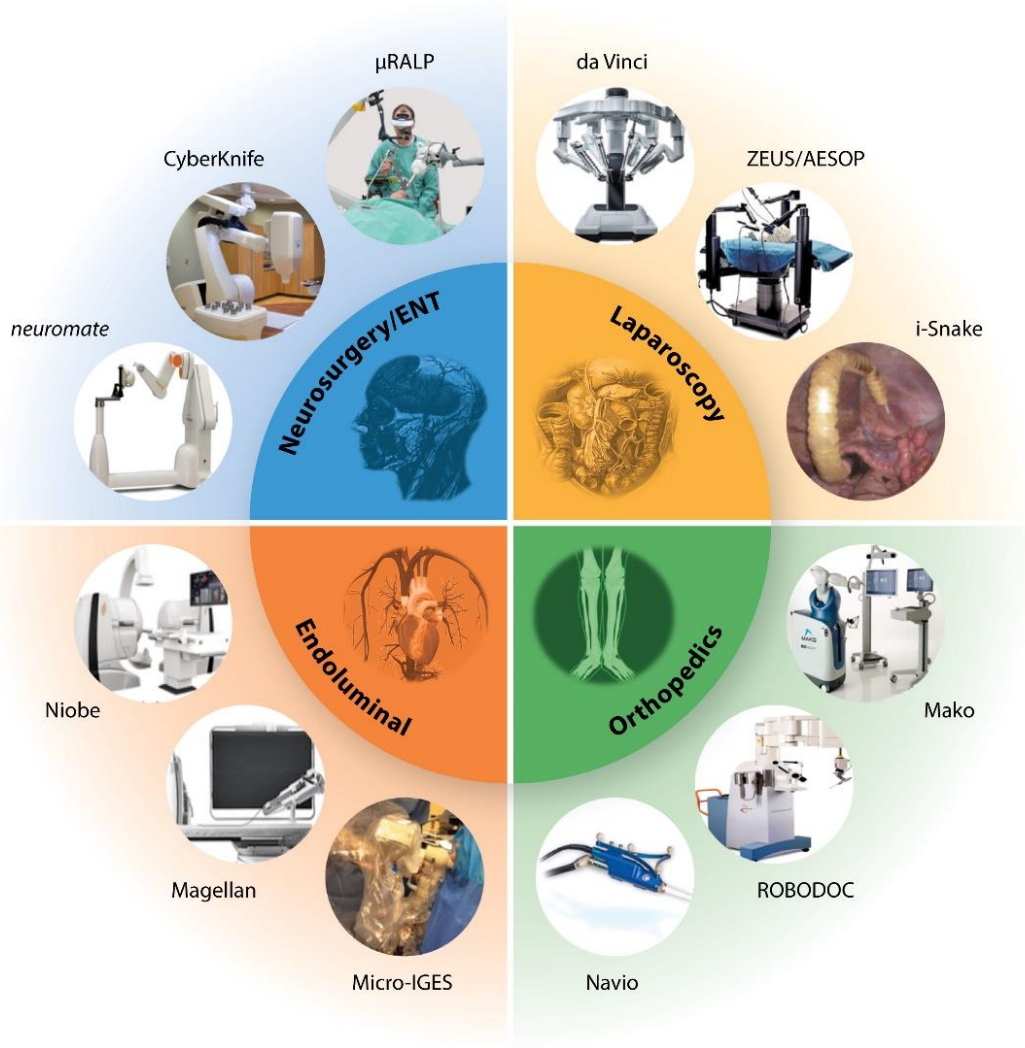


Medical Robotics

Overview

CAGR: Compound Annual Growth Rate



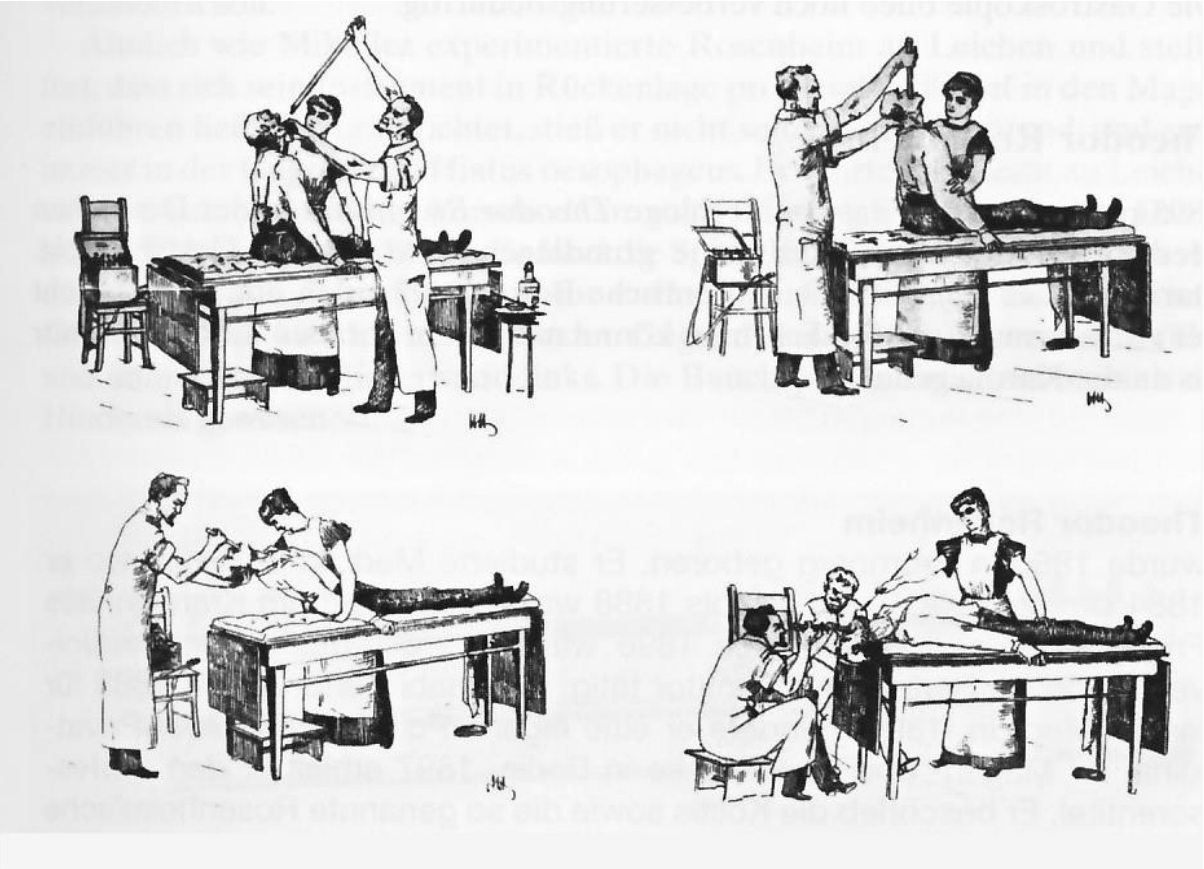


Troccaz J, et al. 2019. *Annu. Rev. Biomed. Eng.* 21:193–218

From Rigid to Continuum Robotics

Endoscopy as a major change

- From rigid endoscopes … to actuated, flexible devices … to robots

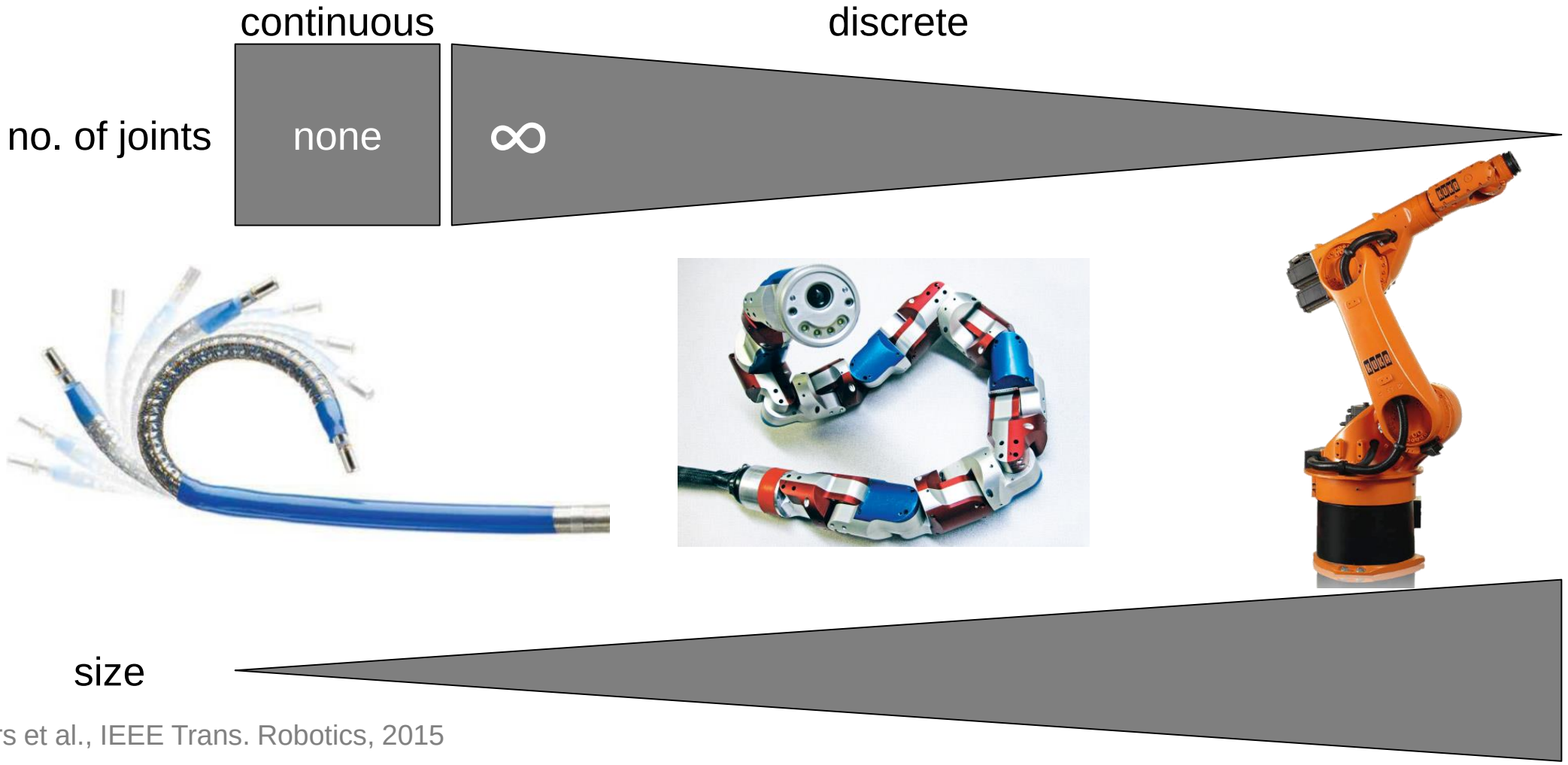


Esophagoscopy – A. Kussmaul, 1868

Dimensions
Material
Actuation
Integration

From Rigid to Continuum Robotics

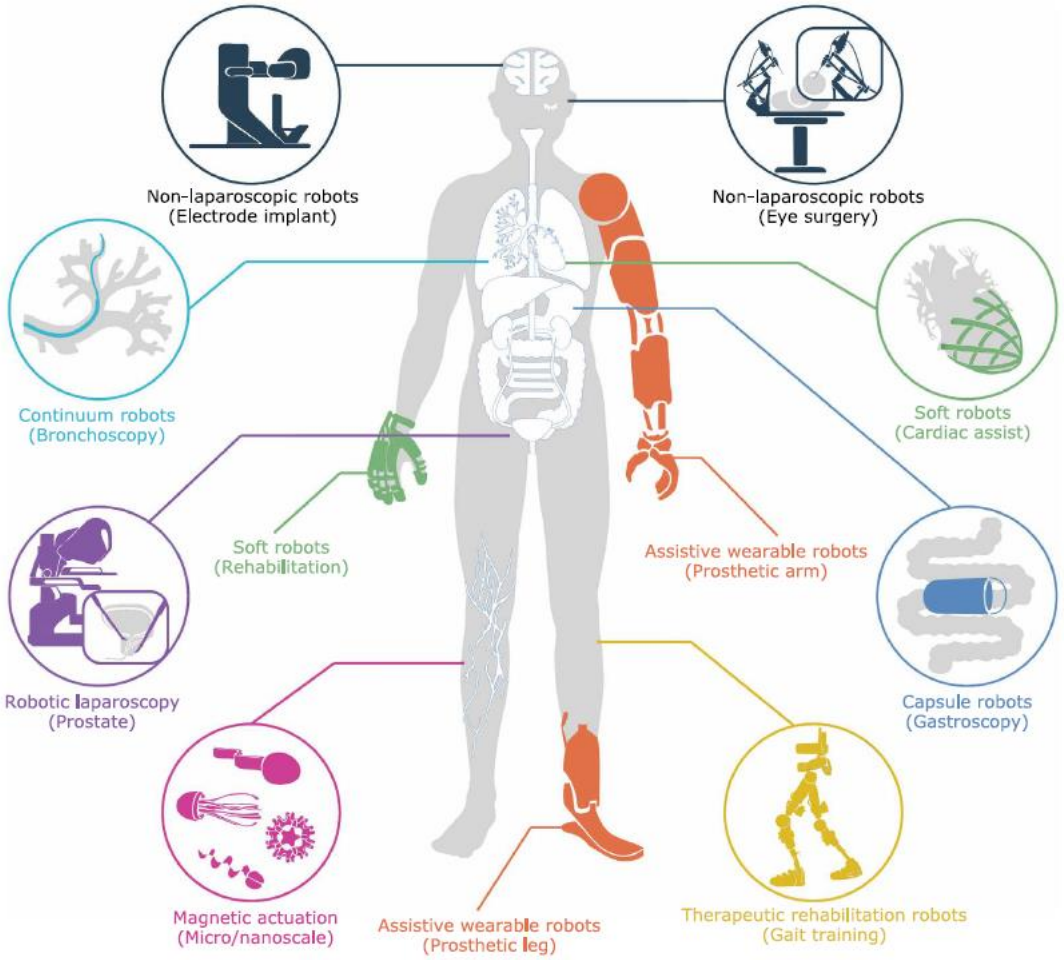
Different paradigm



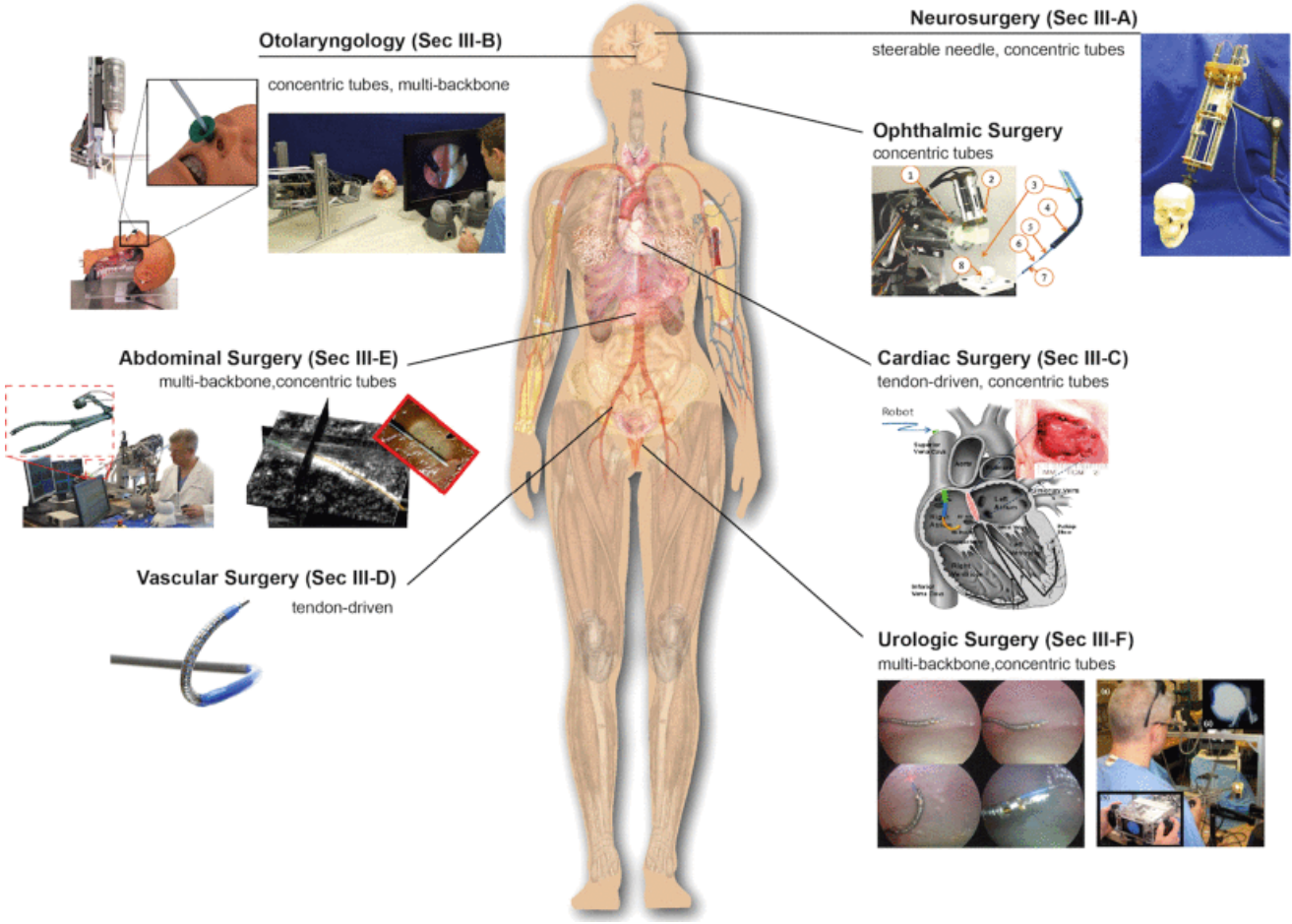
Burgner-Kahrs et al., IEEE Trans. Robotics, 2015

Continuum Robotics

Applications



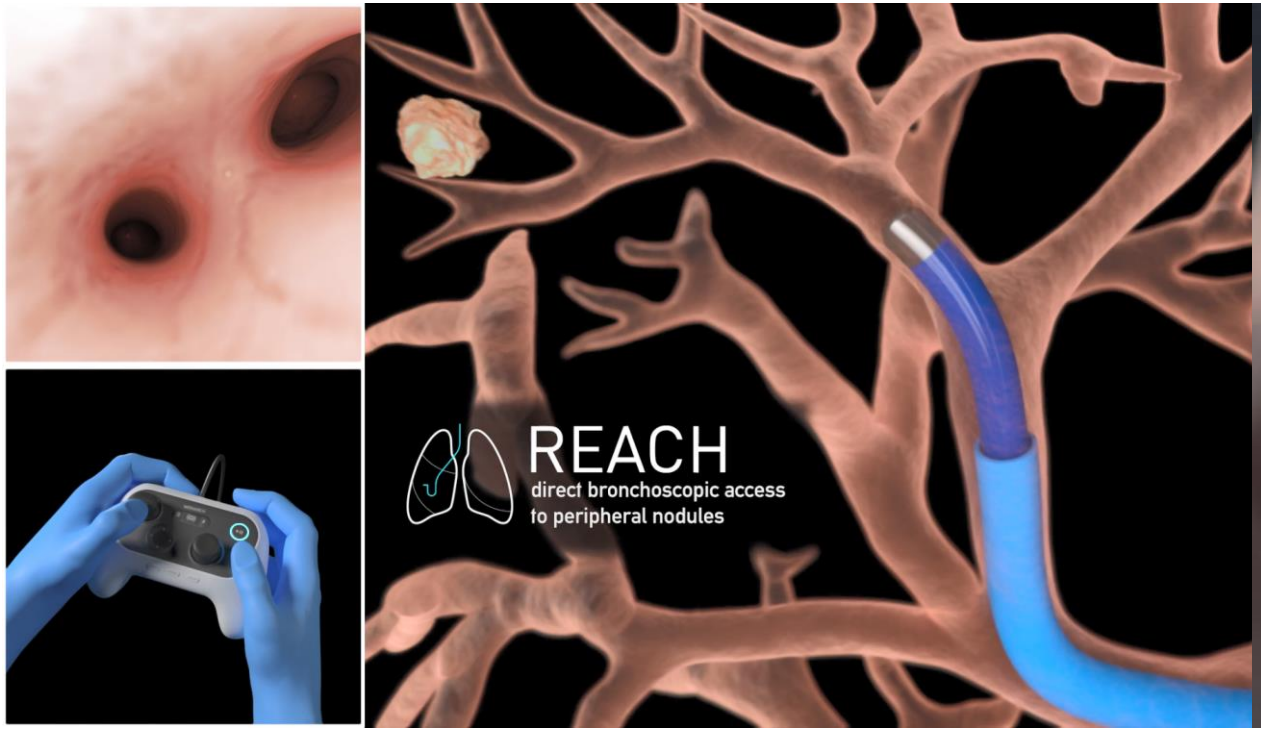
Dupont et al., Science Robotics, 2021

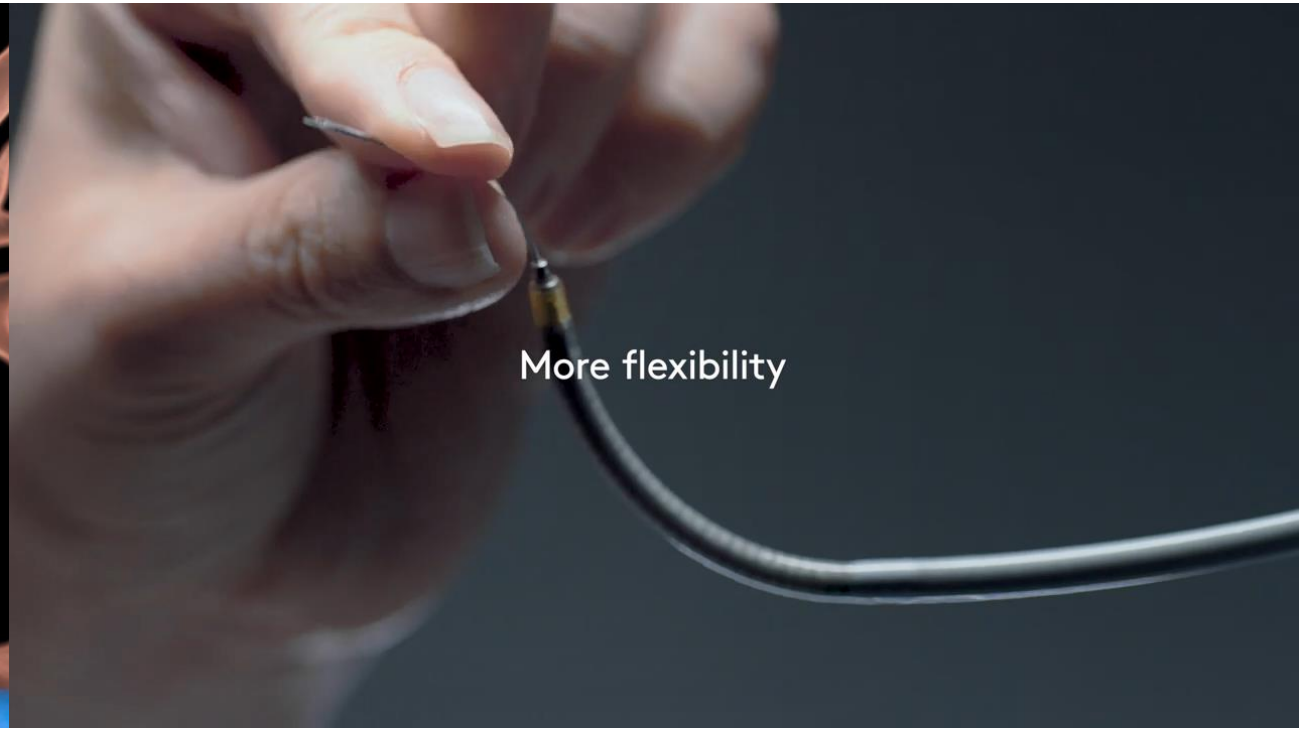


Burgner-Kahrs et al., IEEE Trans. Robotics, 2015

Continuum Robotics

Continuum Medical Robots



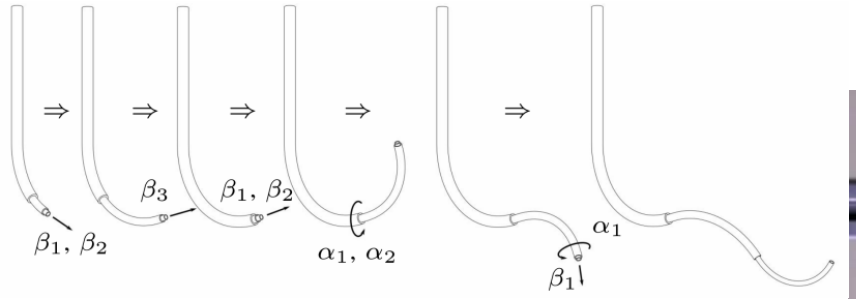


Auris Health, Monarch
FDA clearance 2018
⌀ 4.2 mm

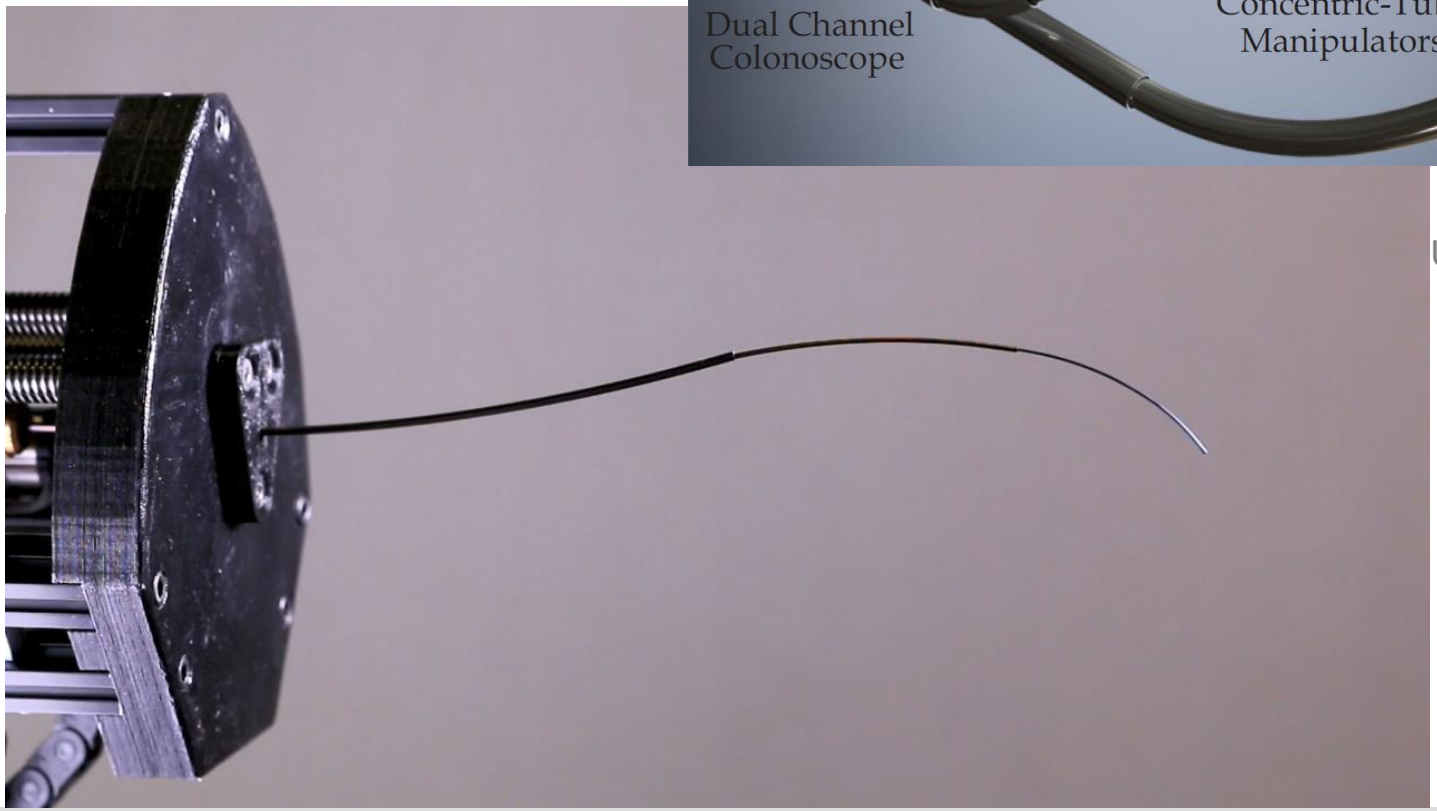
Intuitive Surgical, Ion
FDA clearance 2019
⌀ 3.5 mm

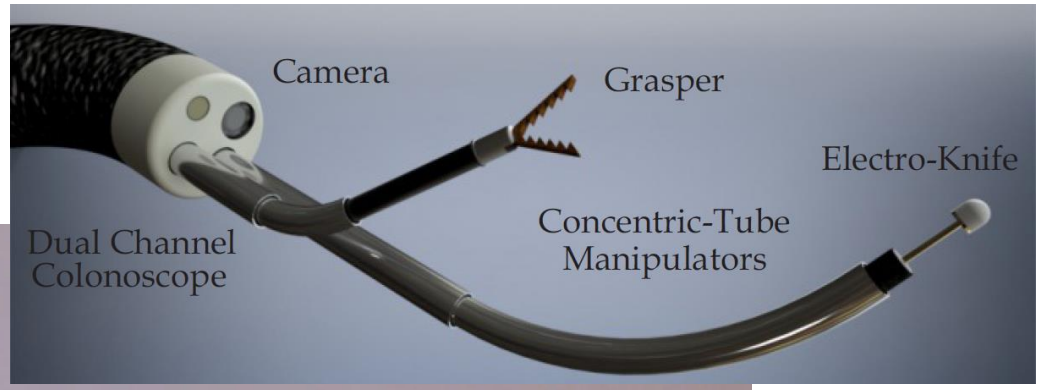
Some Reseach Prototypes

Concentric Tube Continuum Robots



J. Burgner-Kahrs
U. of Toronto
∅ 3.2 mm

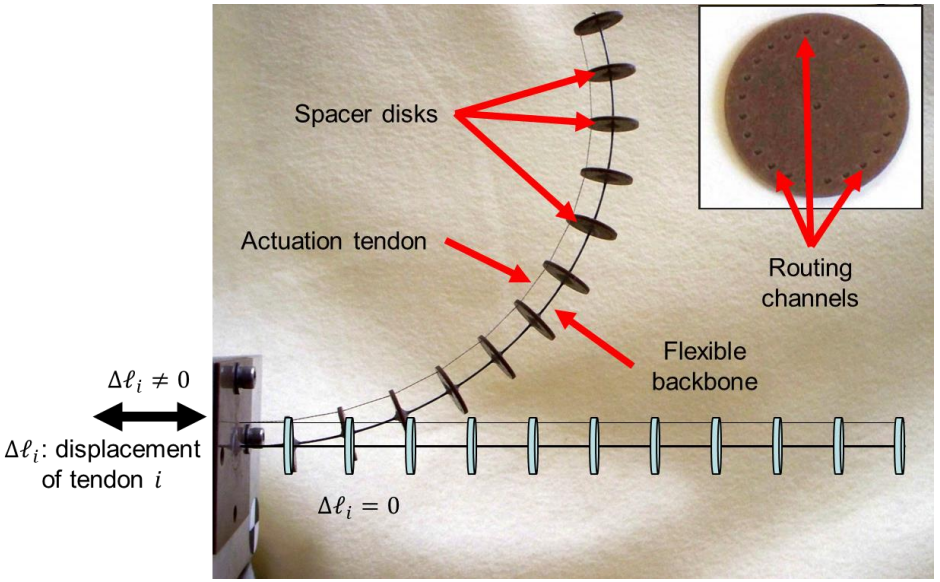


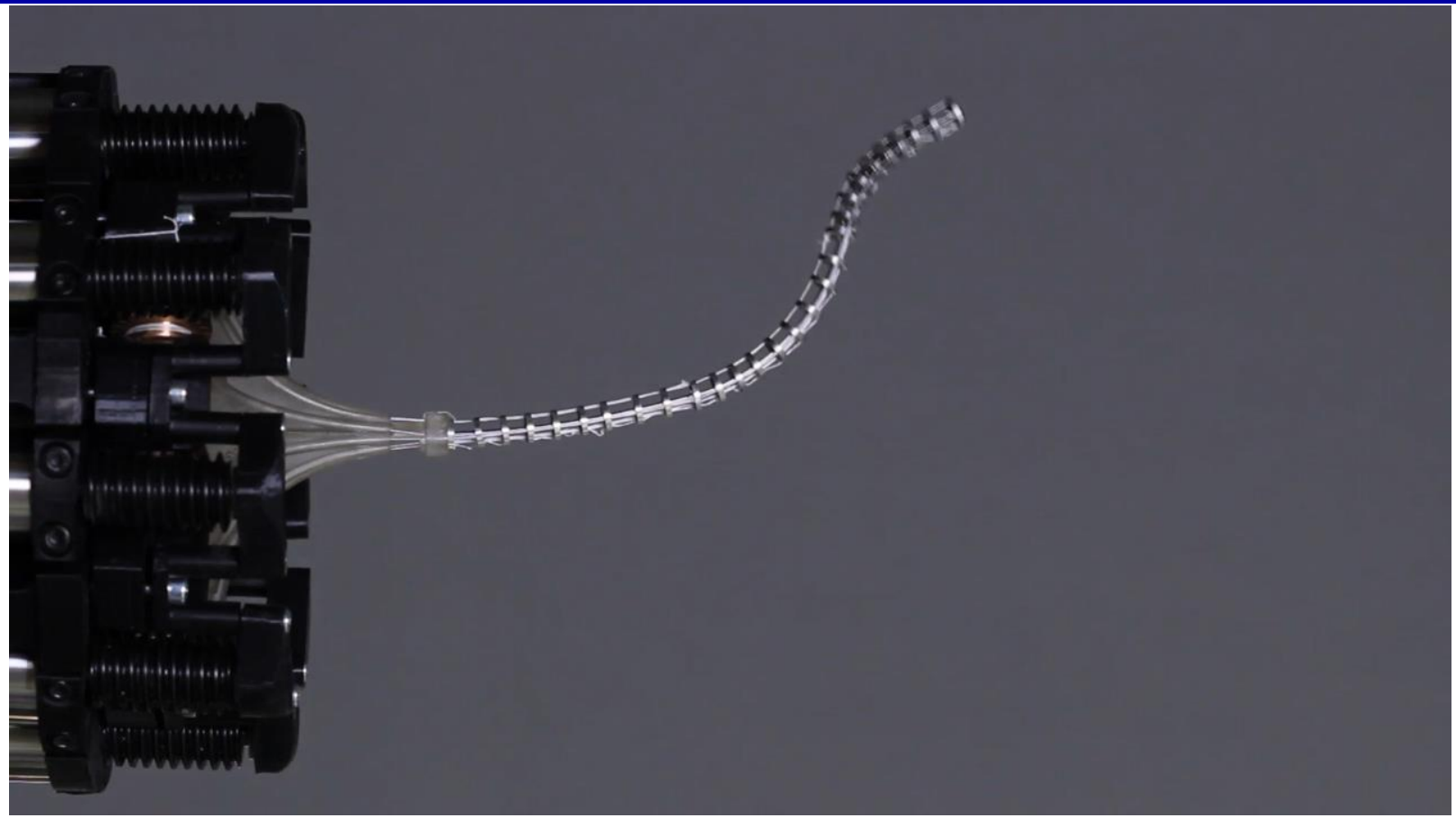


C. Rucker
U. of Tennessee

Some Reseach Prototypes

Tendon-Actuated Continuum Robots



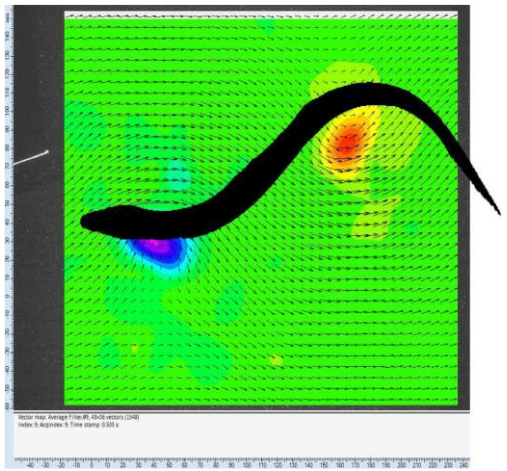


J. Burgner-Kahrs
U. of Toronto
⌀ 8 mm

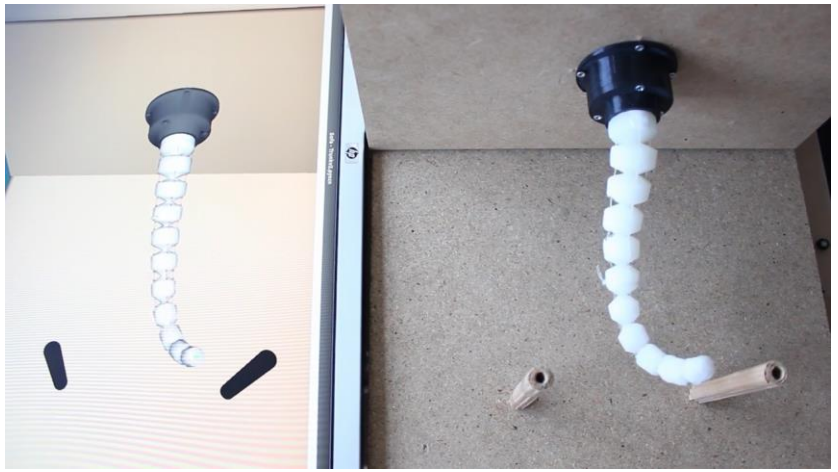
Some Reseach Prototypes

Continuum Robotics at TIMC

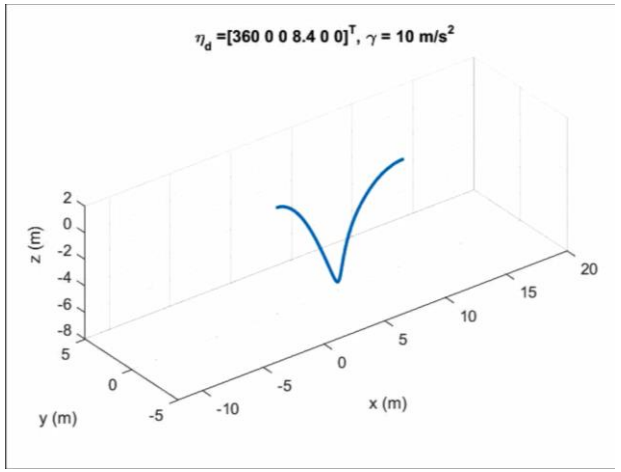
- Tendon-Actuated Continuum Robots
  - Modeling of slender robots for control – ANR project COSSEROOTS



F. Candelier, U. Aix-Marseille



Ch. Duriez, INRIA Lille

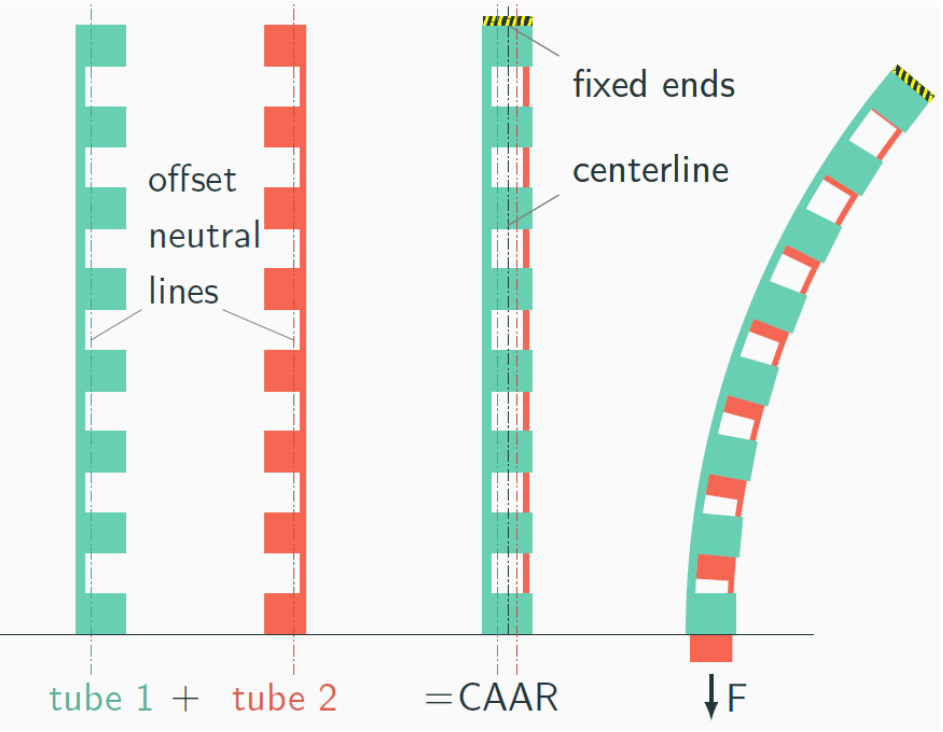


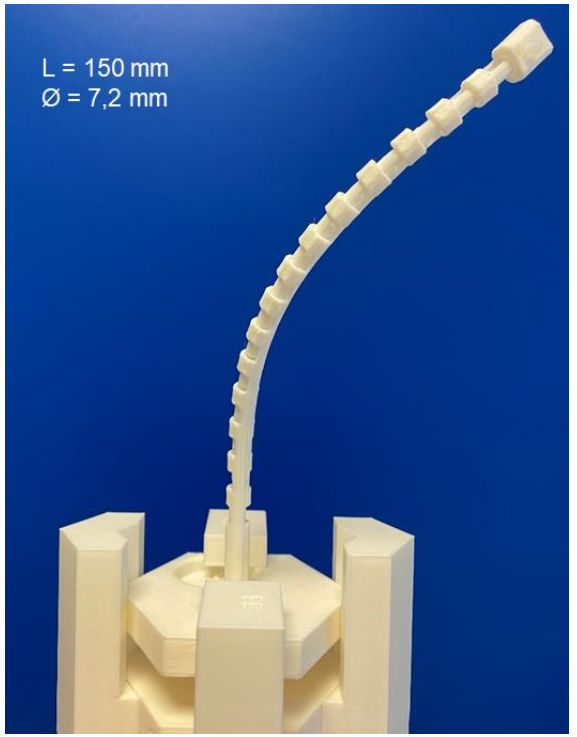
F. Boyer, LS2N, Nantes

Some Reseach Prototypes

Continuum Robotics at TIMC

- Concentric Agonist-Antagonist Continuum Robots
  - Modeling and design of innovative continuum robots – with ICube (Strasbourg)



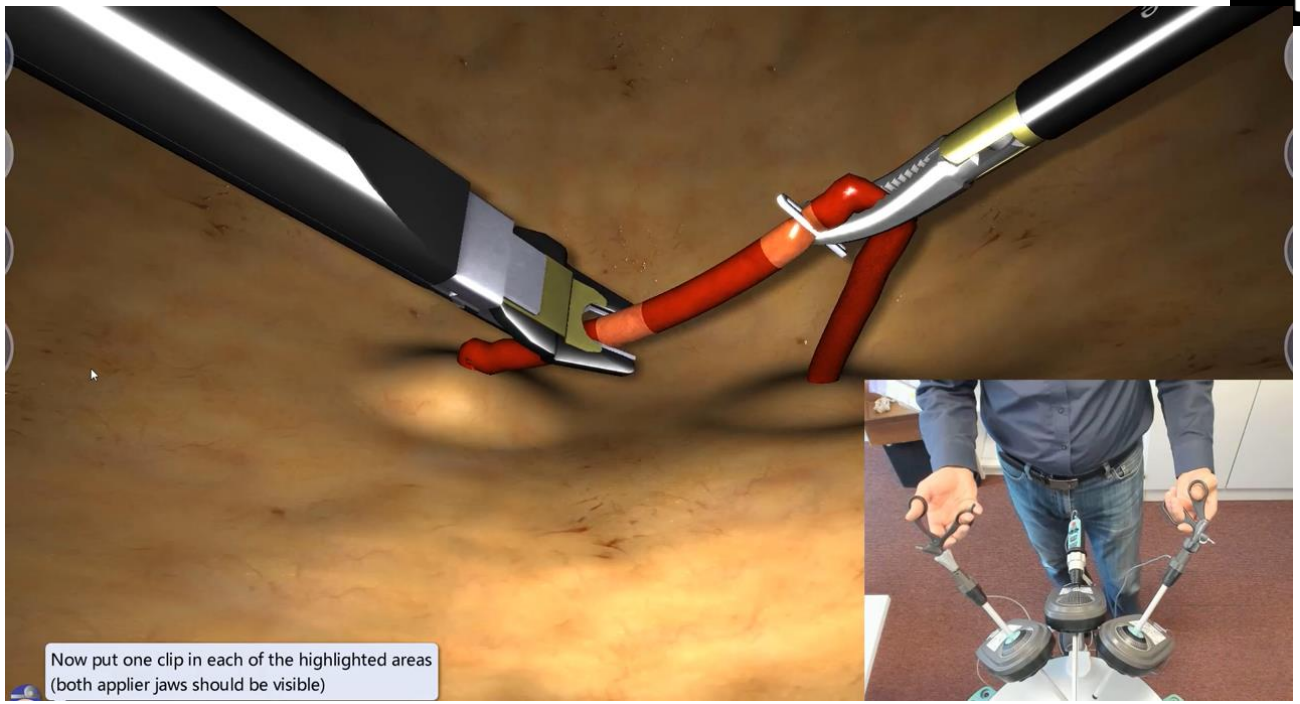


C. Rucker
U. of Tennessee
⌀ 4 mm

Some Reseach Prototypes

Further with CAMI team

- Surgical analytics & open platform
  - Surgical training, simulation and real word data assessment – Equipex+ TIRREX
  - Towards an open platform and simulators of continuum robots



Conclusion

Challenges wrt ATSG

- Perception
  - Tracking/localization, sensor integration/fusion
  - Shape detection
- Reasoning
  - Model-perception fusion, towards closing the control loop
- Action
  - Miniaturized actuation, localized actuation, …

- CDP 2022 : Robots for Real World Interaction (PI: Olivier Aycard – LIG)
  - Fablab MSTIC, GIPSA-lab, G-SCOP, INRIA, LIG, LIP, LJK, LPNC, MSH Alpes, TIMC
  - Usage and application-driven global design, in close collaboration with SSH community

https://www-timc.imag.fr/GMCAO

sites.google.com/view/ctaha

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