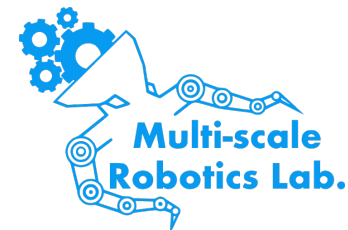
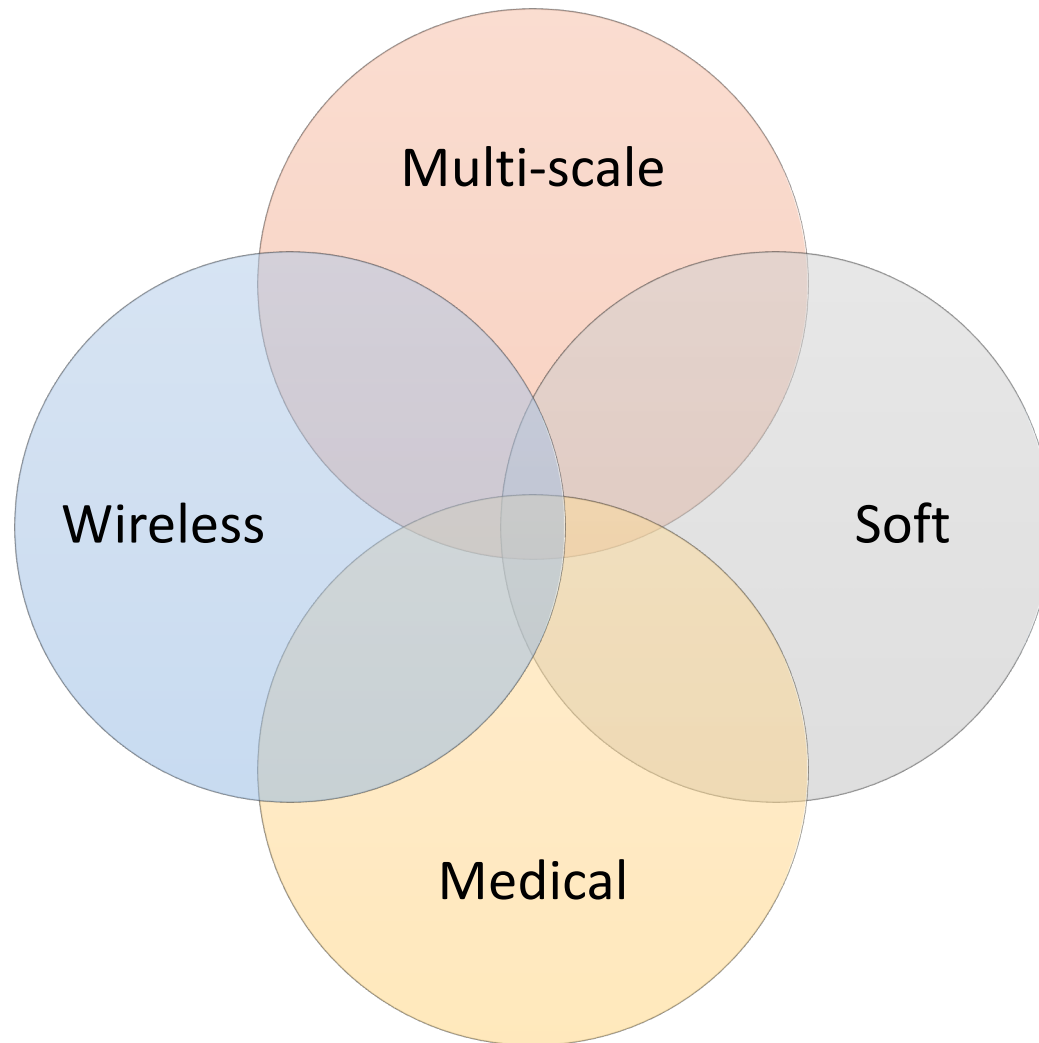


# Multi-Scale Robotics Laboratory 연구 소개

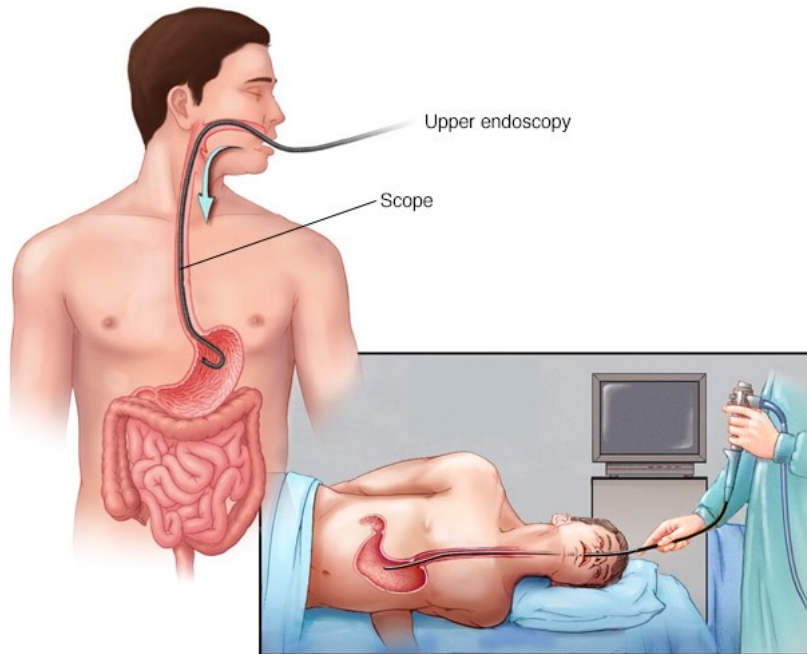
손동훈  
멀티스케일 로보틱스 연구실  
부산대 기계공학부





# **Capsule Robot**

# Endoscopy

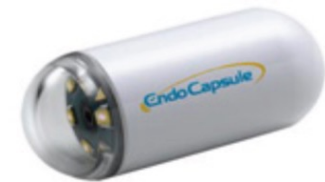


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Invasive procedure



Pillcam, Given Imagings (2001)



Endo-capsule, Olympus (2005)

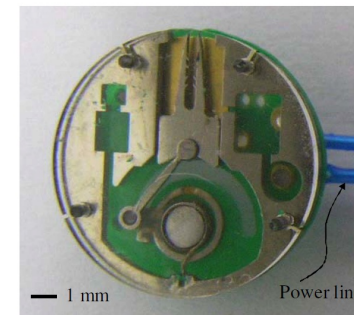
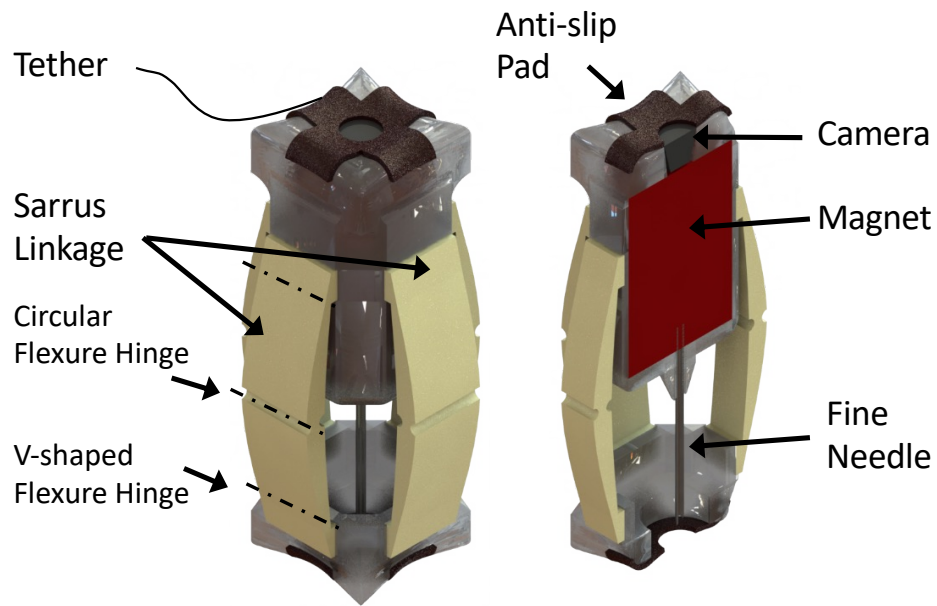
Non-invasive procedure

# Magnetically Actuated Soft Capsule Endoscope for Biopsy



D. Son, M. D. Dogan, and M. Sitti, "Magnetically actuated soft capsule endoscope for fine-needle aspiration biopsy," in *IEEE International Conference on Robotics and Automation (ICRA)*, 2017, **Best Paper Finalist in Medical Robotics**

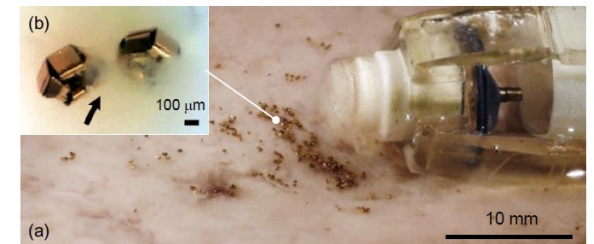
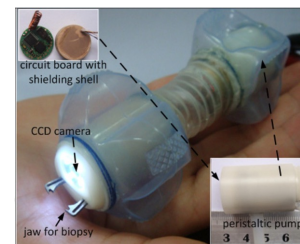
# Smart Soft Design with Medical Function



Park et al. (2008)



Kong et al. (2012)

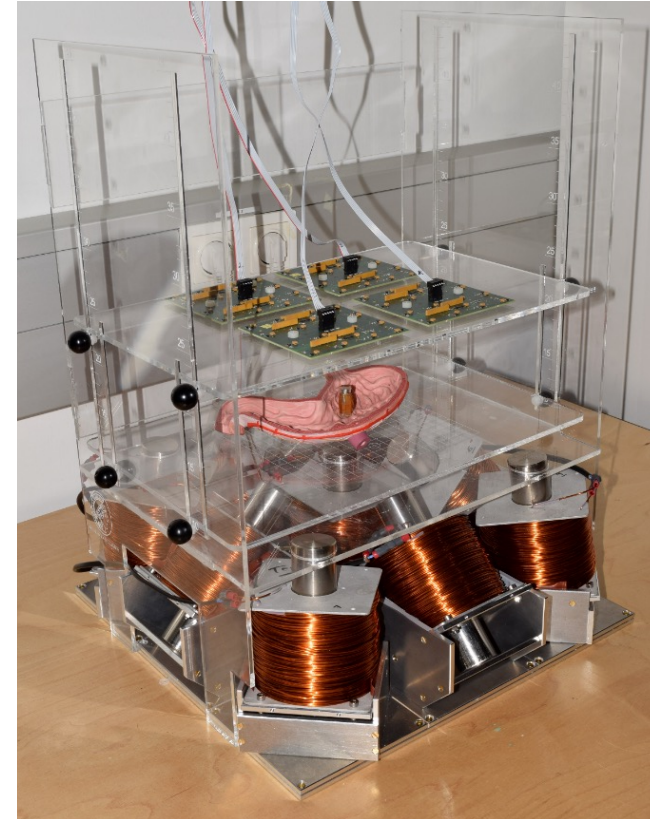


Yim et al. (2014)

# Comparison: Classical Robot vs Magnetic Robot

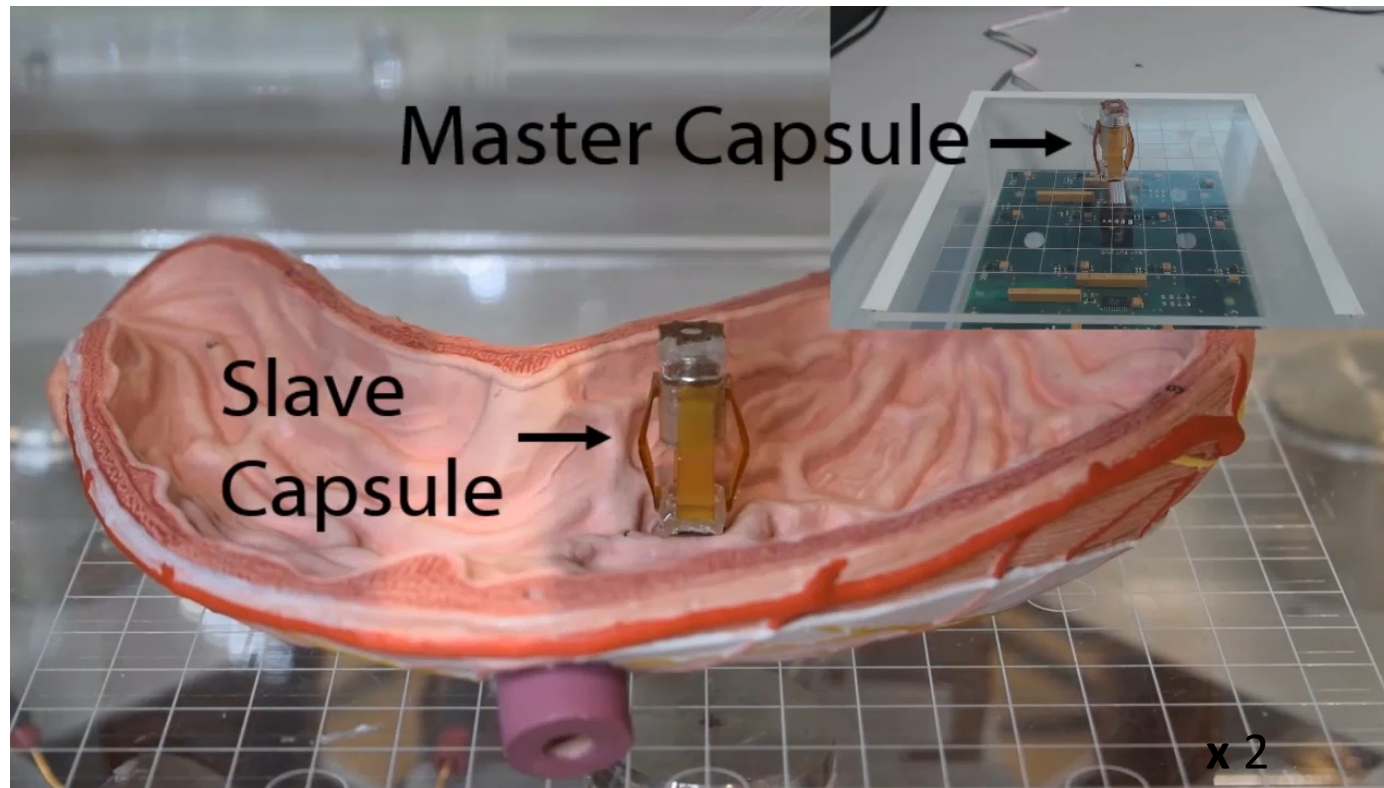


Da Vinci®, Intuitive Surgical



9 Coil System, Son et al. (2018)

# Teleoperated Manipulations

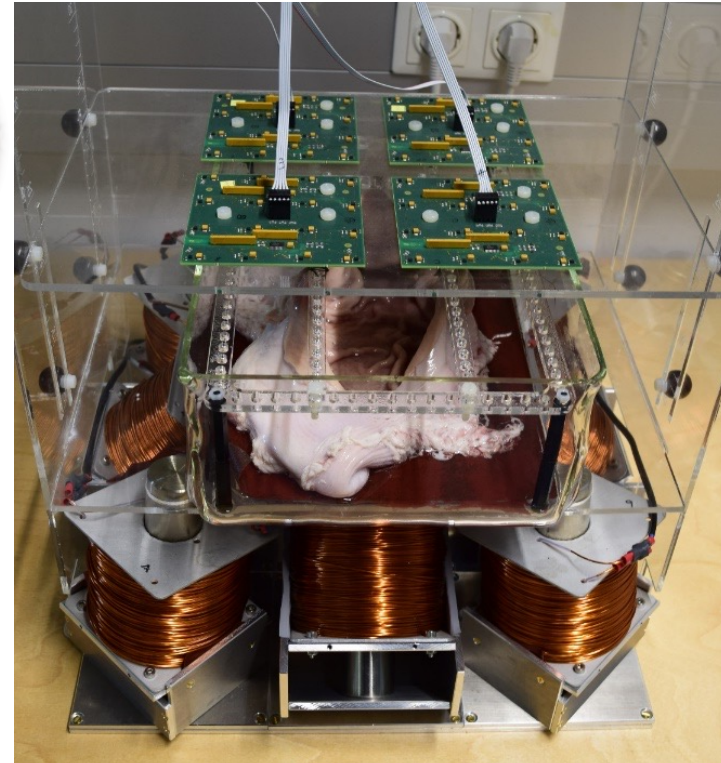
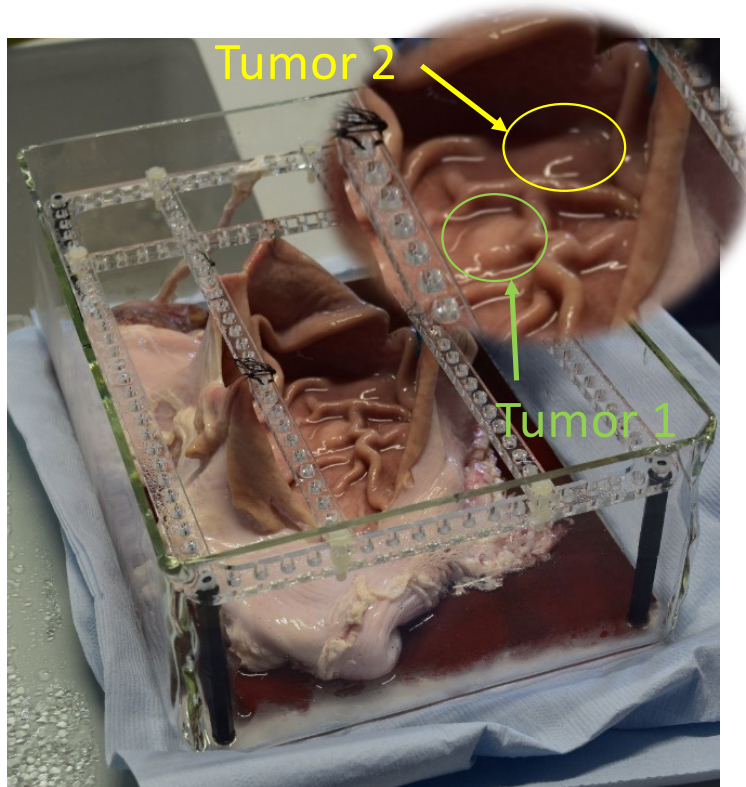


D. Son, S. Yim, and M. Sitti, "A 5-D Localizaiton...," *IEEE TMECH*, 2016

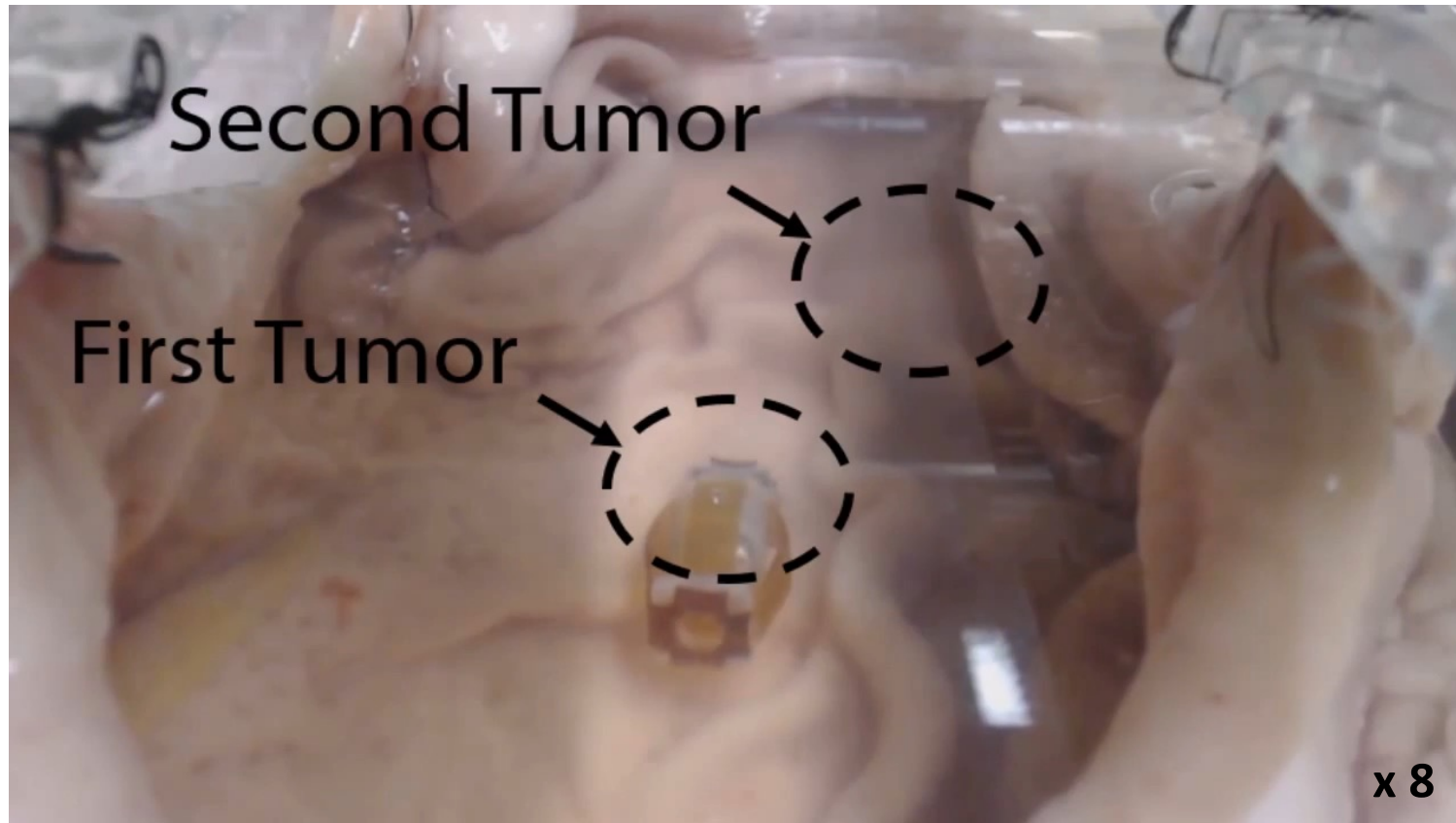
D. Son, X. Dong, and M. Sitti, "A Simultaneous Calibration...," *IEEE TRO*, 2018

D. Son, H. Gilbert, and M. Sitti, "Magnetically Actuated Soft ...," *Soft Robotics*, 2020

# Phantom Model Preparation



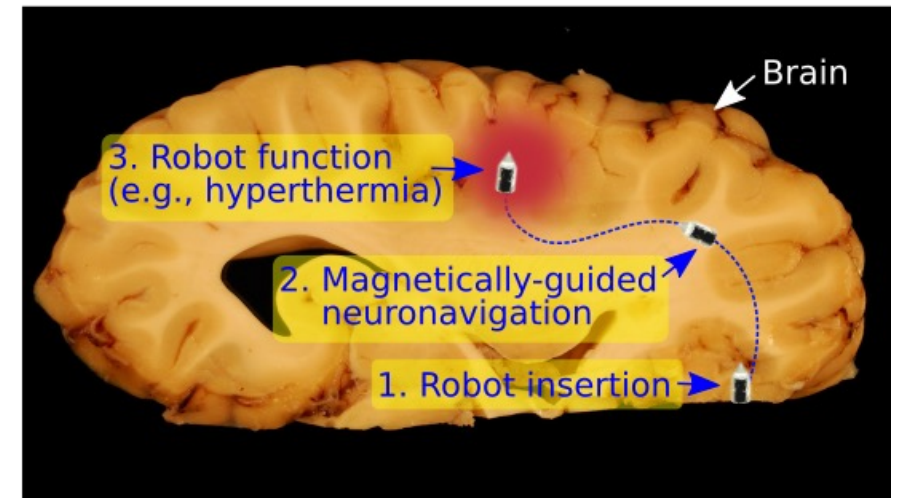
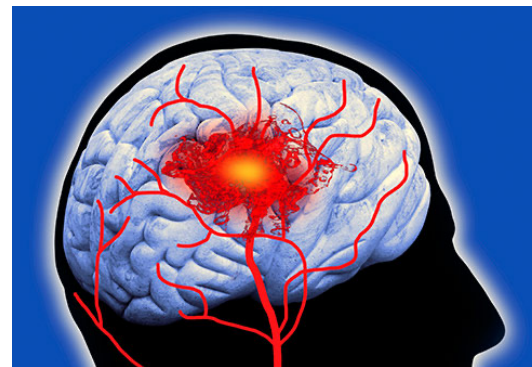
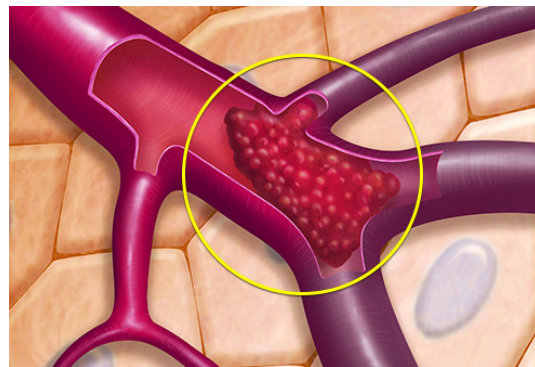
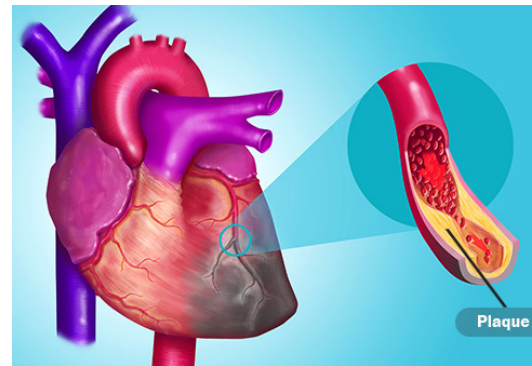
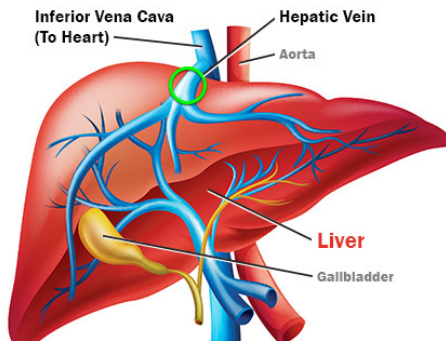
# Ex Vivo Experiments



D. Son, H. Gilbert, and M. Sitti, "Magnetically Actuated Soft Capsule Endoscope for Fine-Needle Biopsy," *Soft Robotics*, vol. 7, no. 1, 2020.

# **Micro-robot in Body Tissue**

# Miniaturization for Untethered Tissue Navigation

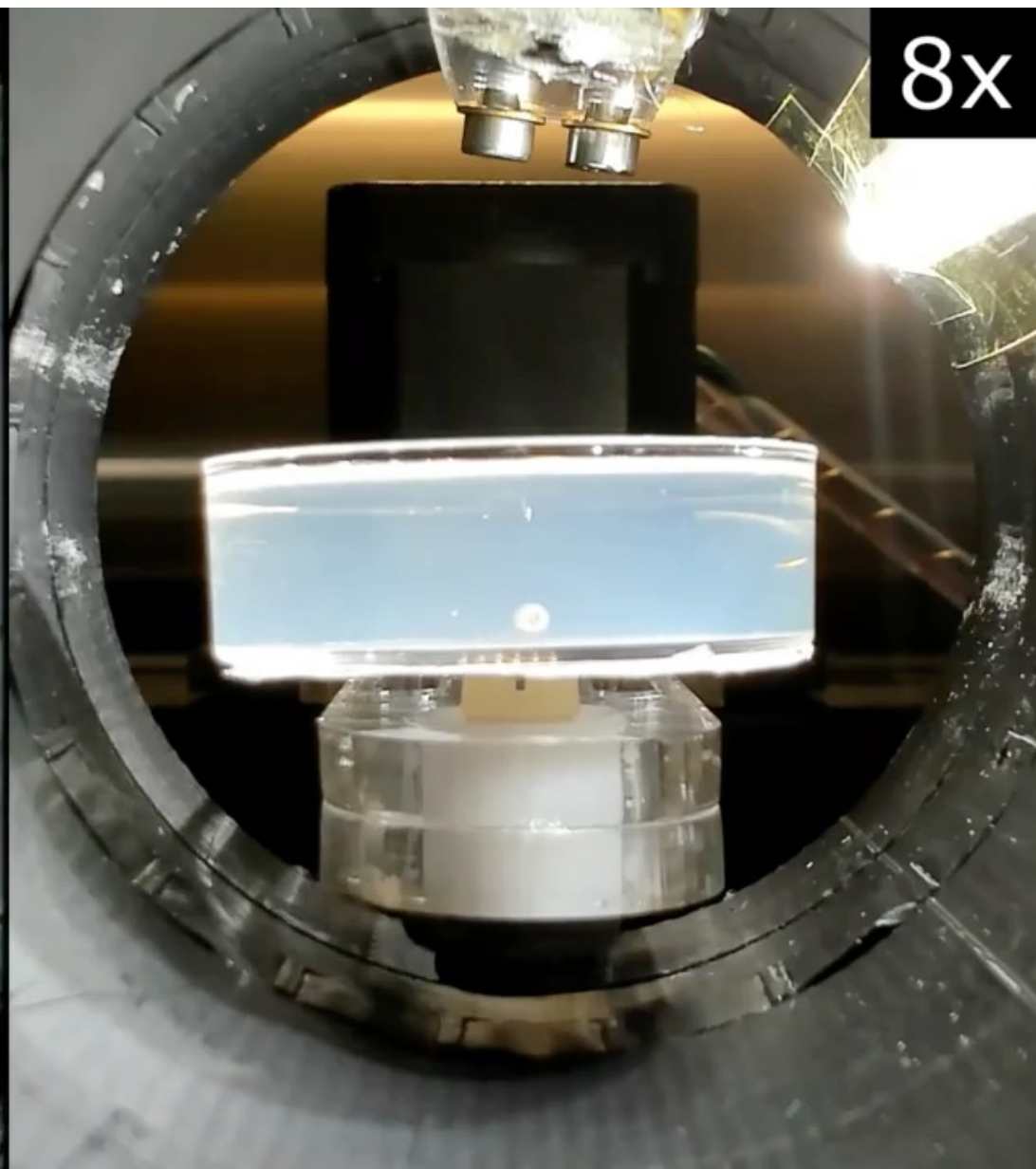


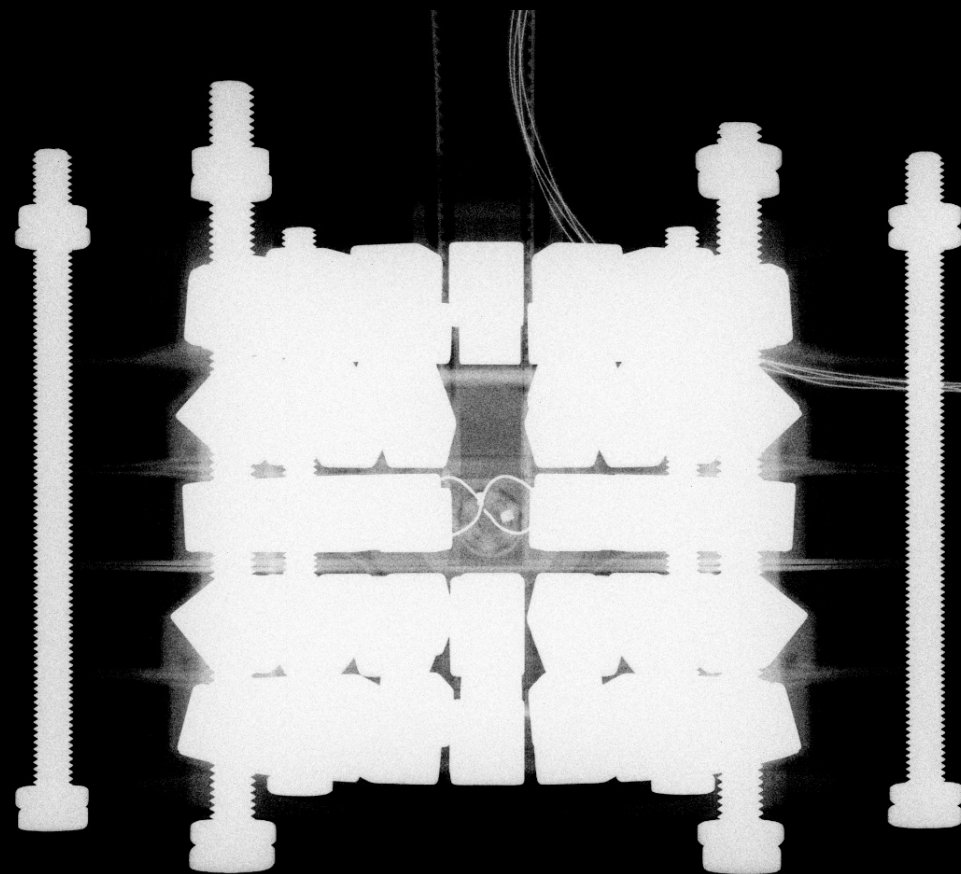
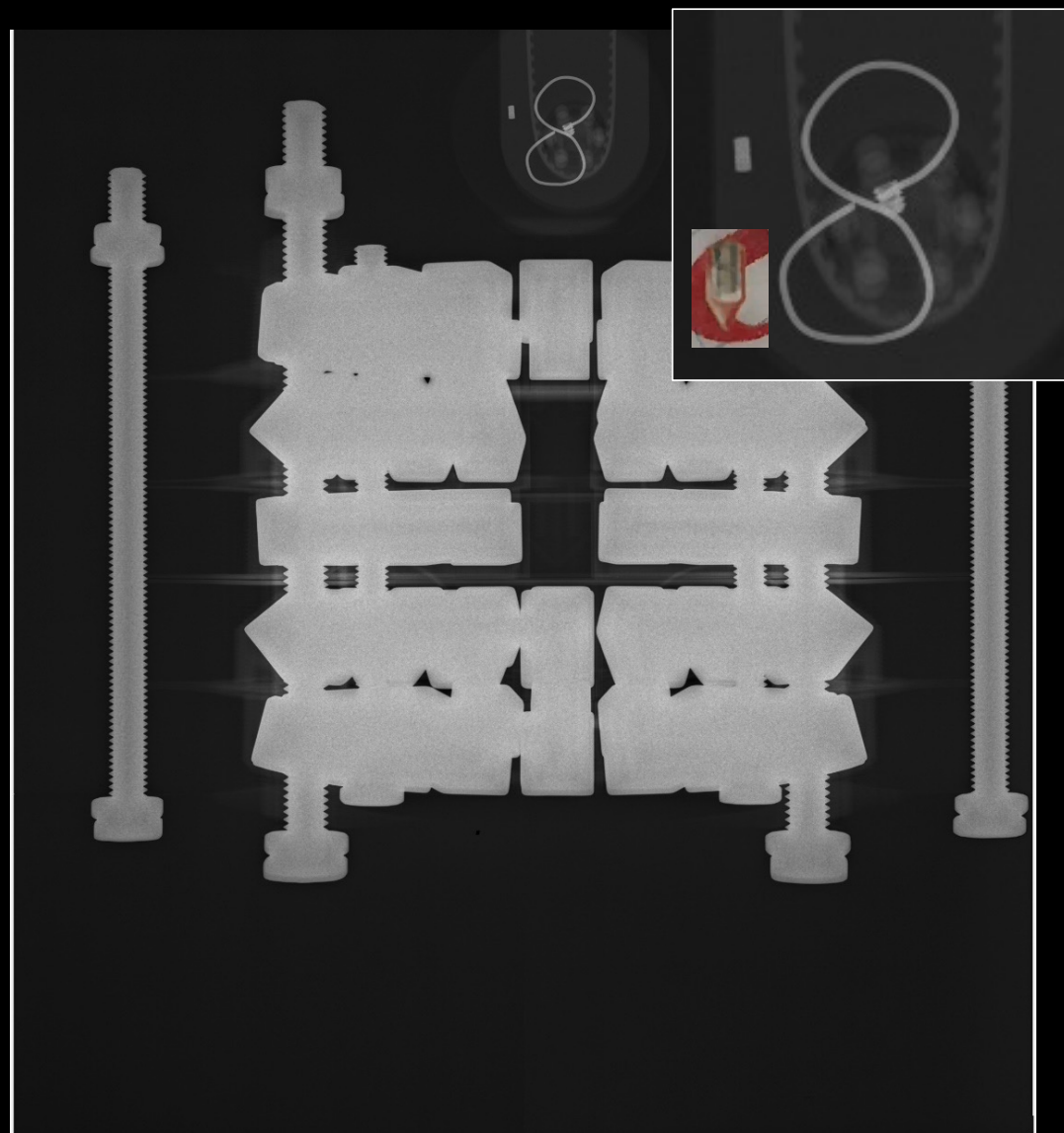
Webmd.com

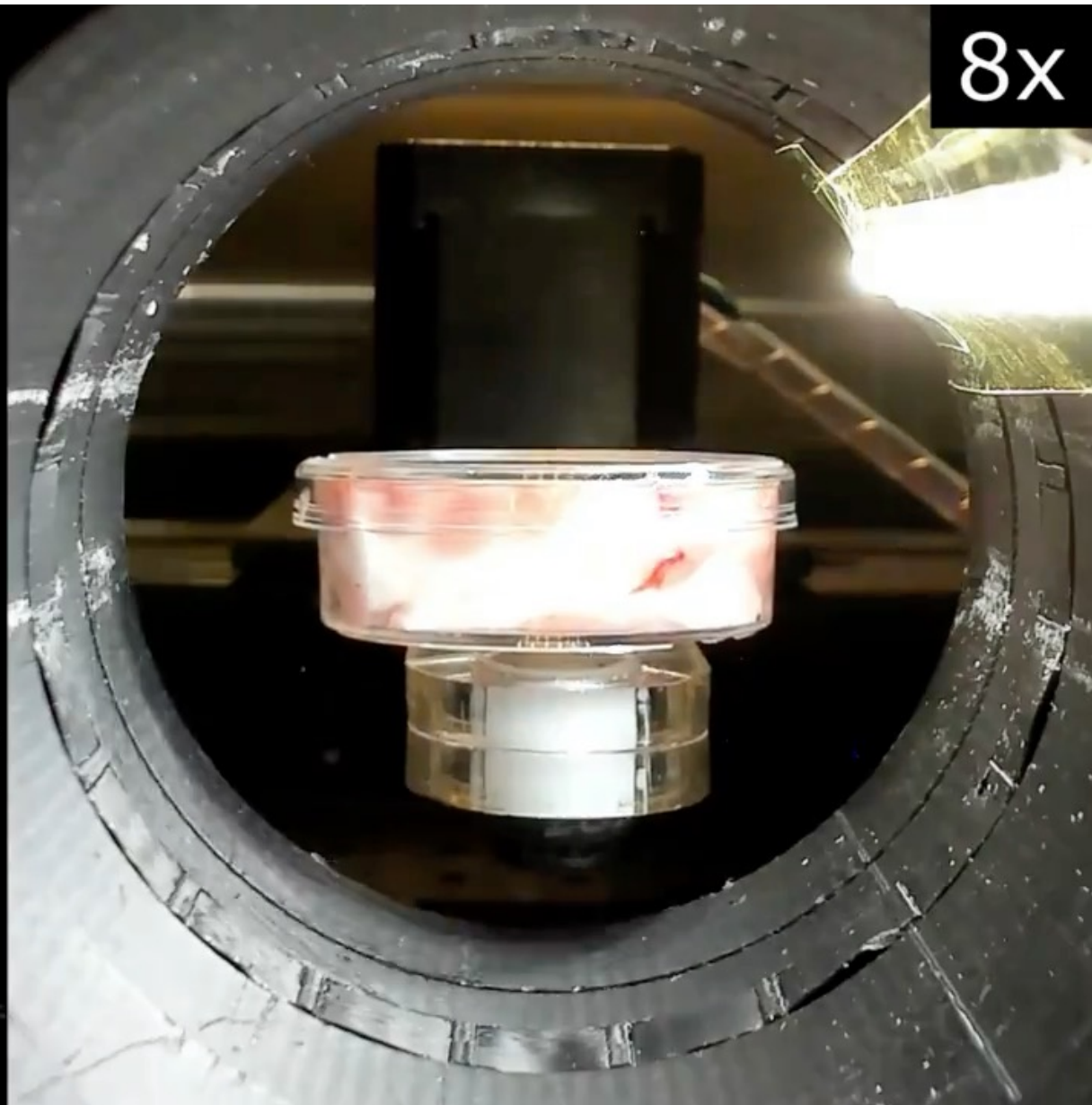
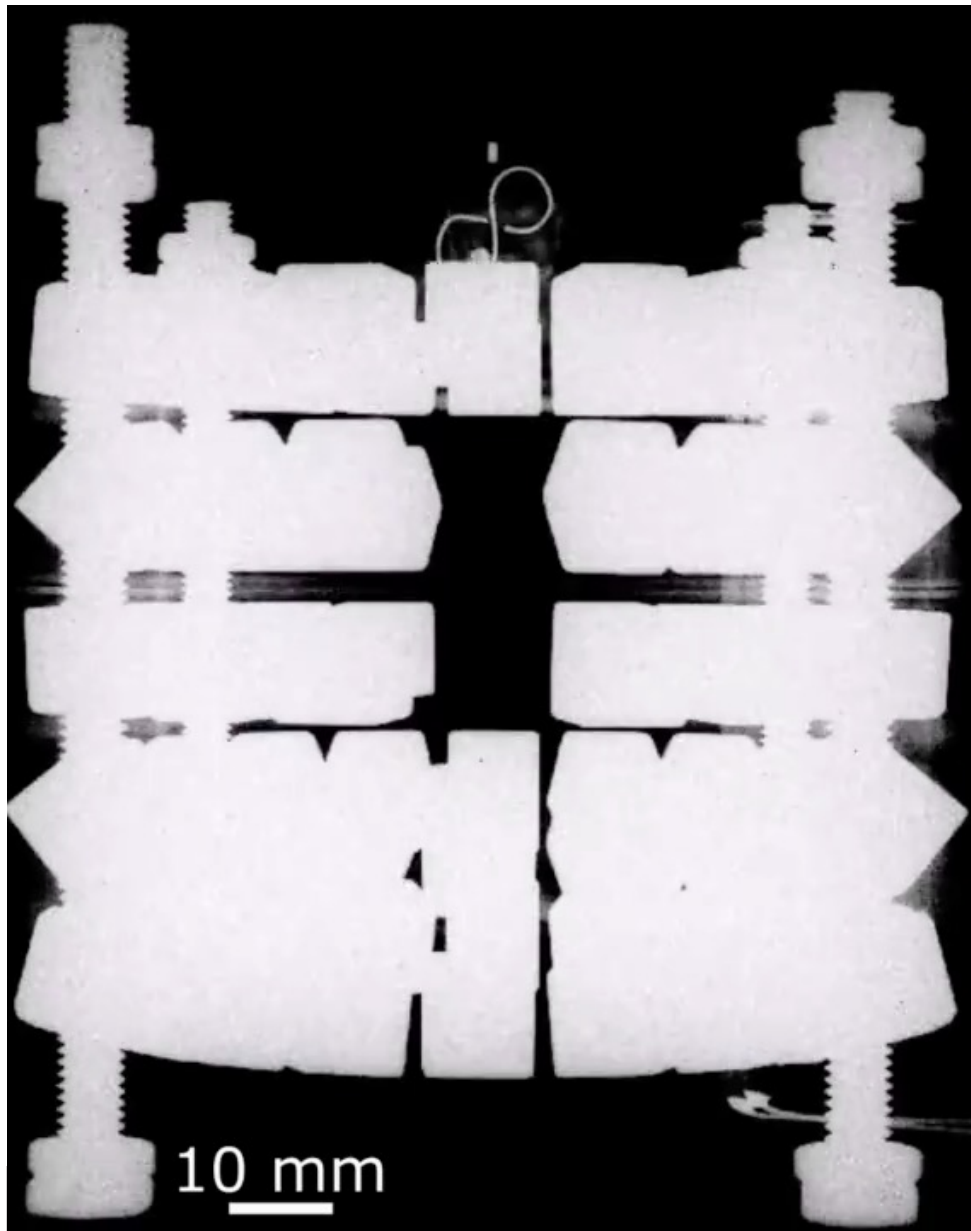
# Magnetic Force Trap



D. Son, M. Urgulu, and M. Sitti, "Permanent Magnet Array-driven Navigation of Wireless Millirobots inside Soft Tissues," *Science Advances*, vol. 7, no. 43, Oct 2021







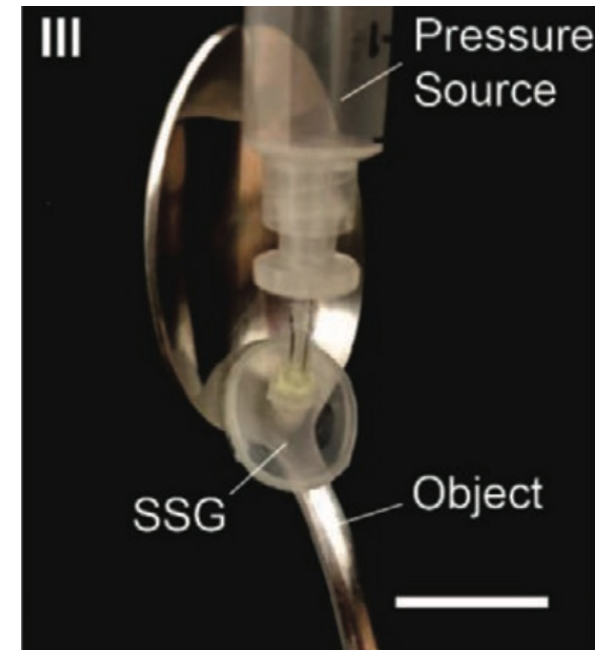
# **Soft Grippers**

# Soft Grippers

Hard Grippers

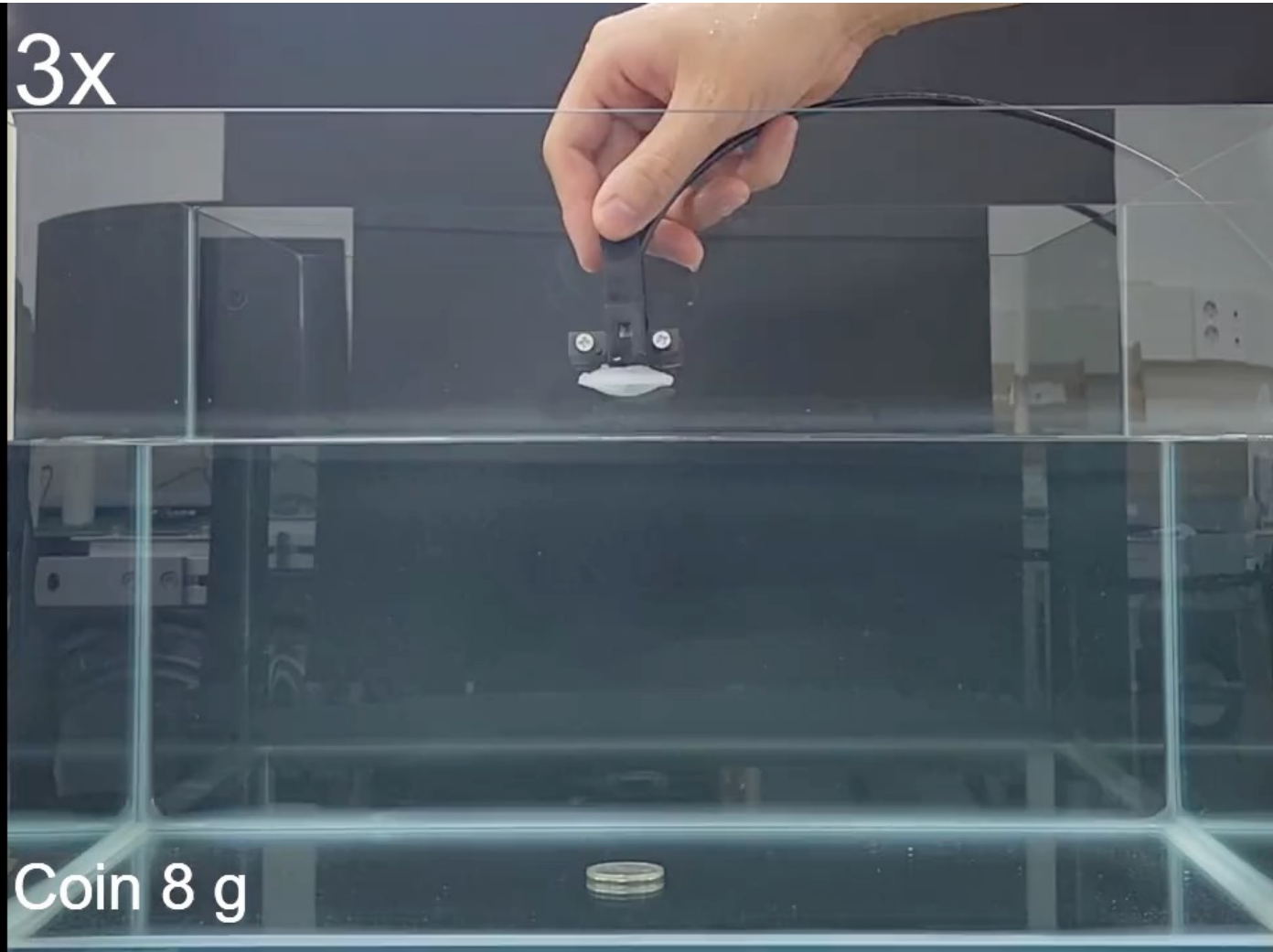


Soft Grippers



Hard, Complex, Expensive, Computation

Soft, Simple, Economical, Adaptive



3x

Coin 8 g



Thank you for your attention

<https://sites.google.com/view/msrl/d.son@pnu.edu>