



**ÓBUDA UNIVERSITY**

IROB – ANTAL BEJCZY CENTER  
FOR INTELLIGENT ROBOTICS

## **Surgical subtask automation on the Da Vinci Research Kit**

*Tamás D. Nagy*

*Supervisor: Tamás Haidegger*

Antal Bejczy Center for Intelligent Robotics  
EKIK – University Research, Innovation and Service Center  
Óbuda University

## Traditional surgery

- Big incisions
- „The bigger the wound, the greater the surgeon.”



“OKAY, FIVE BUCKS SAYS I CAN GO SHOULDER DEEP.”

## Minimally Invasive Surgery (MIS)

- Small incisions
- Rapid recovery
- Hard for the surgeon



## Benefits

- Ergonomy
- Accuracy
- 3D vision

## Da Vinci Surgical System

- Teleoperated
- 5 generations
- 5400+ units worldwide
- 1M operations/year



Image credit: Intuitive Surgical Inc., Sunnyvale, CA

## Research kit for surgical robotics

- Open-source HW & SW
- Read/write access to the da Vinci arms
- Compatible with the 1<sup>st</sup> generation da Vinci
- ROS interface
- >35 setups worldwide

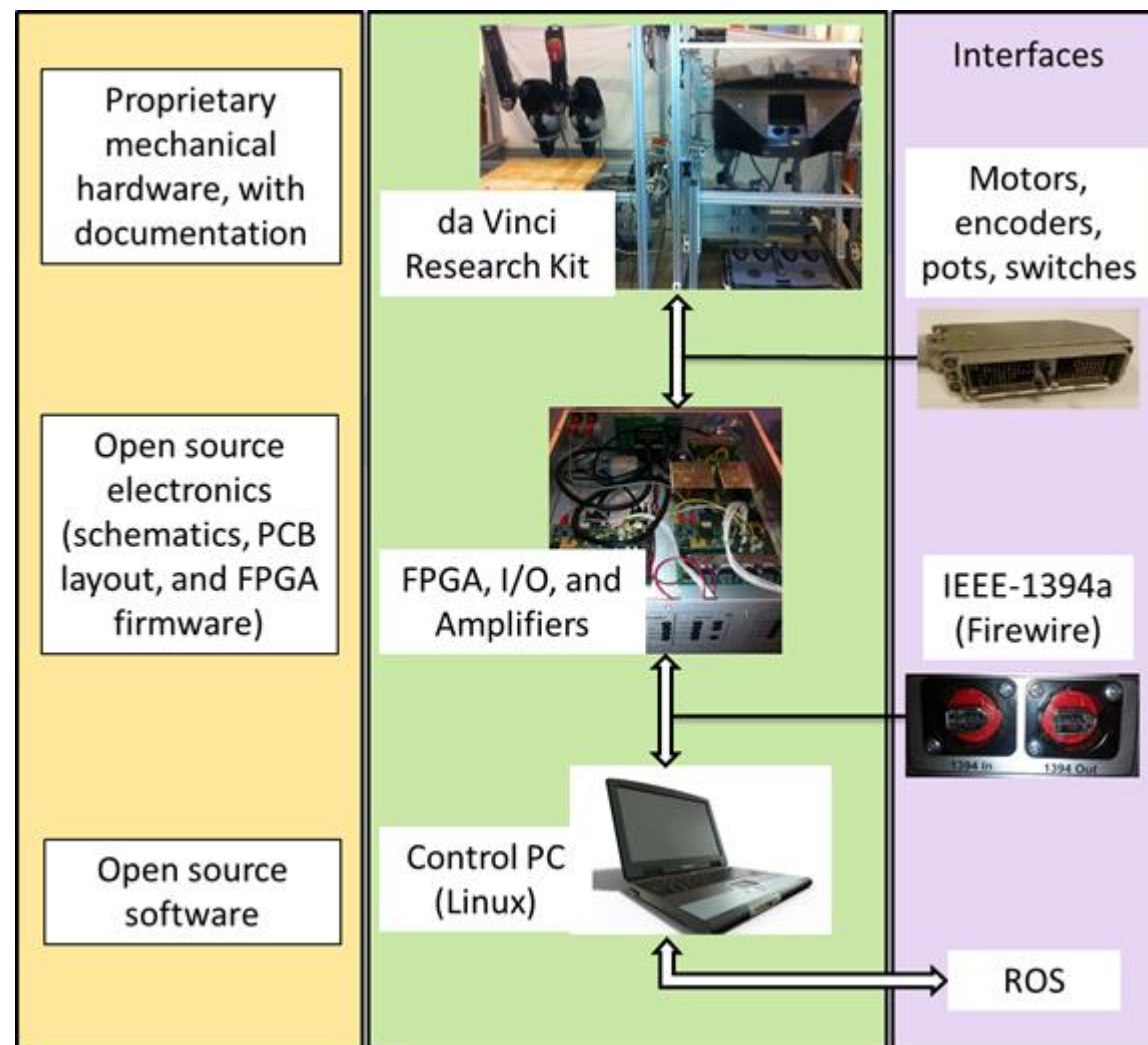
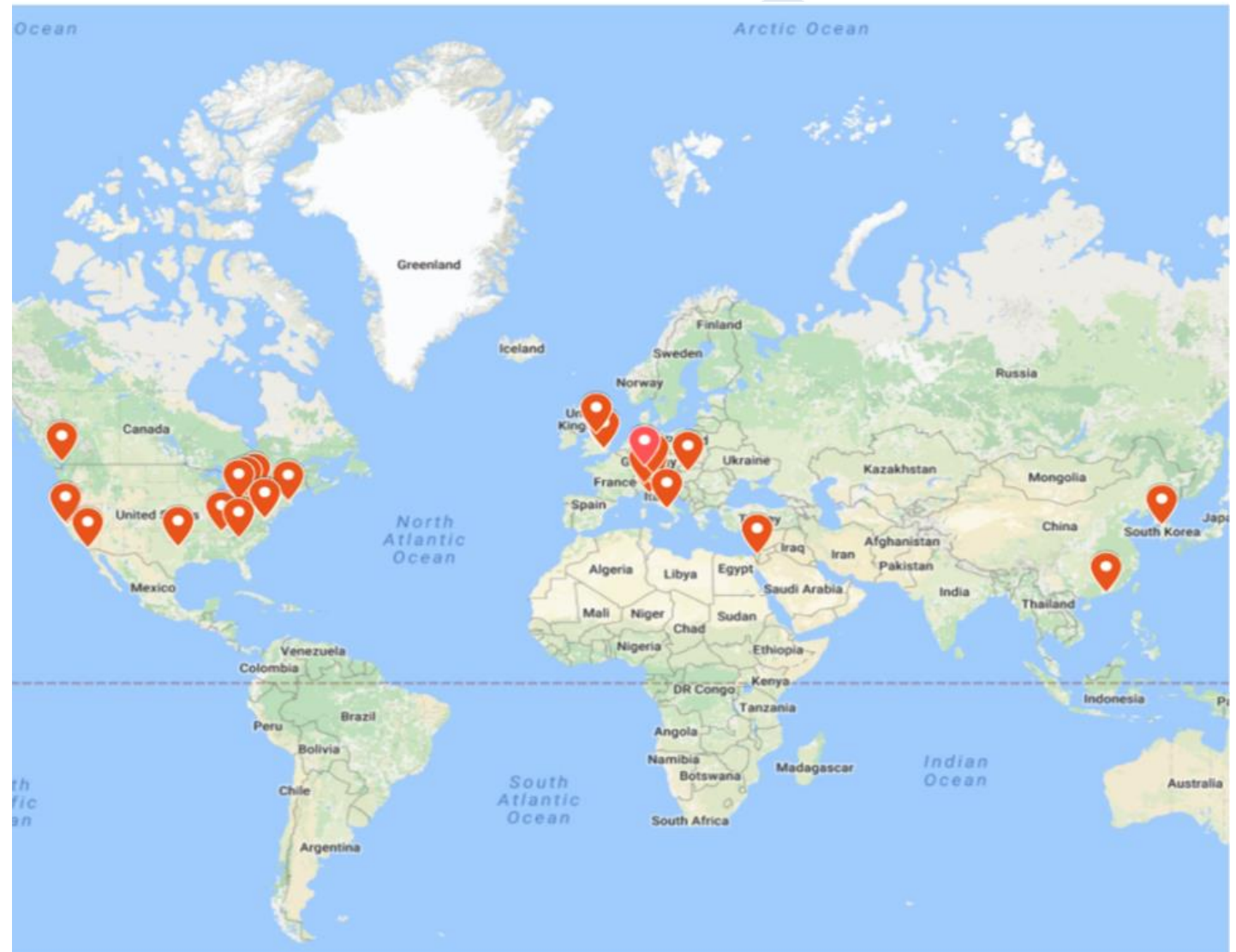


Image credit: SMARTS, JHU

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## Why do we need automation?

- Monotonous tasks
- Time-consuming tasks
- Decrease cognitive load on the surgeon

## Surgical automation – easy task?

- Hard tissues: relatively
  - Bone drilling
- Soft tissues: no
  - Constantly changing environment



Image credit: AUTOLAB, UC BERKELEY

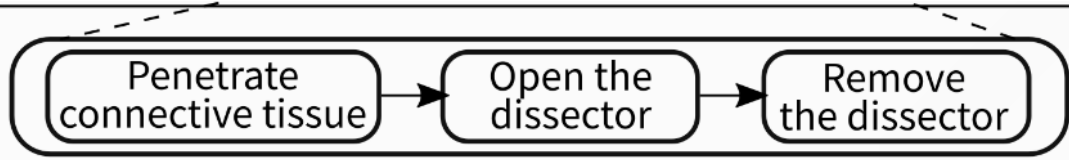
Level of granularity	Time span	Complexity	Example
Operation	20-200 min	very high	Laparoscopic cholecystectomy
Task	1-5 min	high	Pneumo-peritoneum → Exposing-Calot's triangle → ...
Subtask	0.1-2 min	moderate	Retraction of the gallbladder → Blunt dissection at the Cystic duct → Blunt dissection at the Cystic art. → ...
Surgeme	0.1-0.5 min	low	Approach the tissue ↔ Perform dissecting motion → ...
Motion primitive	1-5 sec	very low	Penetrate connective tissue → Open the dissector → Remove the dissector

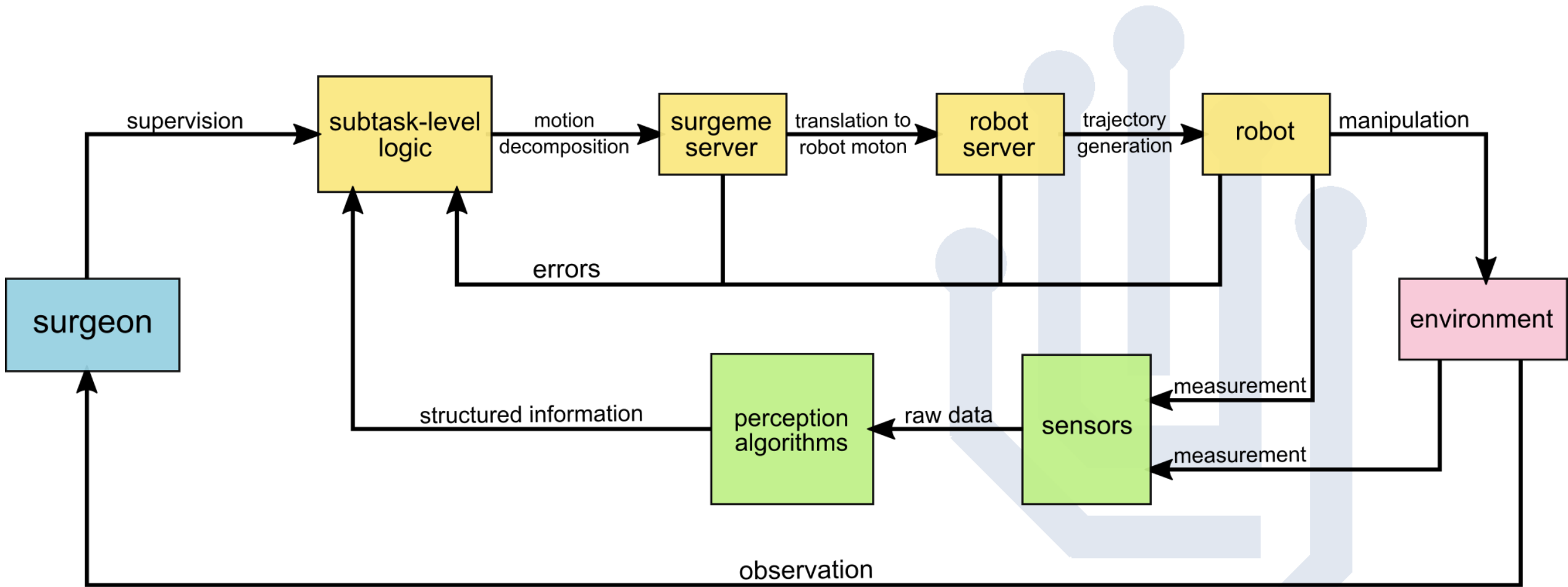
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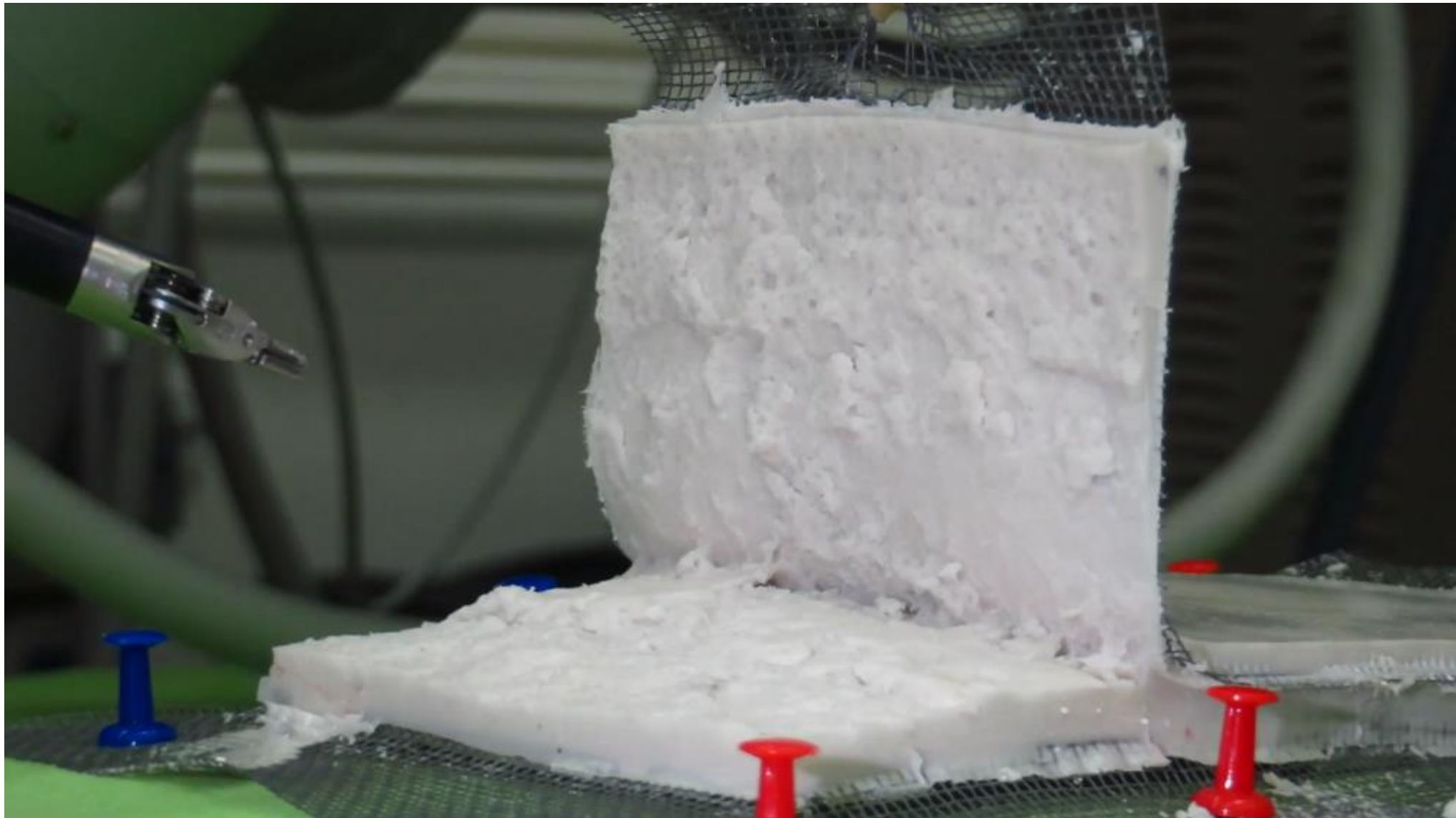


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- Framework for surgical subtask automation
- Parameterizable surgemes
- Universal building blocks
- ROS communication

Open-source implementation available on GitHub:

[https://github.com/ABC-iRobotics/dvrk\\_carla](https://github.com/ABC-iRobotics/dvrk_carla)

## Antal Bejczy Center for Intelligent Robotics

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<http://irob.uni-obuda.hu>

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# Thank you!

