

# Robotic assistance for enhancing the accuracy of gestures in reconstructive microsurgery

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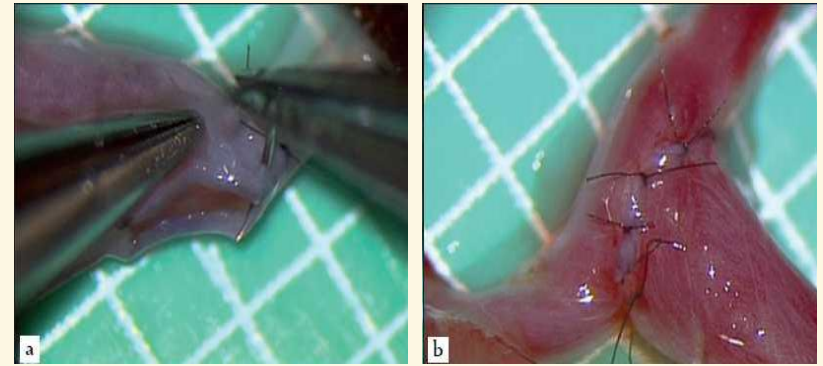
**Current status: just started**



# Microsurgery

## Typical procedures

- **Anastomosis:** connection between two blood vessels, two hollow viscera or two nerve fibers
- **Free flap:** auto-graft of tissue from one site of the body to another



Micro-anastomosis on graph tissue



**Sub-millimeter accuracy required**

**Limiting factor:** surgeon dexterity

**Solution:** robotic assistance



# Existing systems

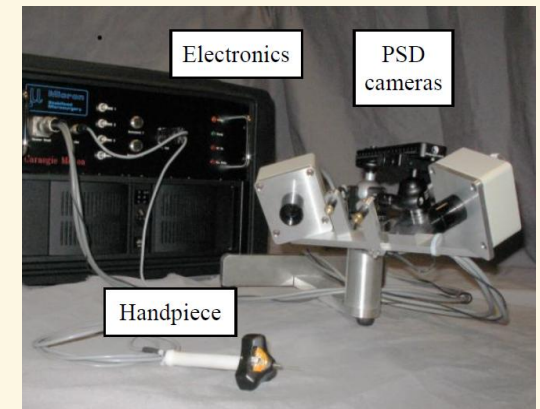
## Da Vinci (Intuitive Surgical)

- Remote teleoperation system for keyhole abdominal and thoracic surgery
- Downscaling of gestures
- Very expensive, cumbersome, surgeon away from operative site



## Micron (Carnegie Mellon University)

- Hand-held robot (serial co-manipulation)
- Active tremor cancellation by visual servoing
- Expensive technology (custom high-speed camera and piezoelectric actuators)

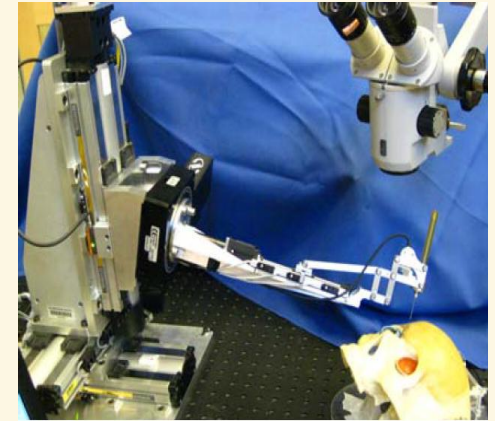




# Existing systems

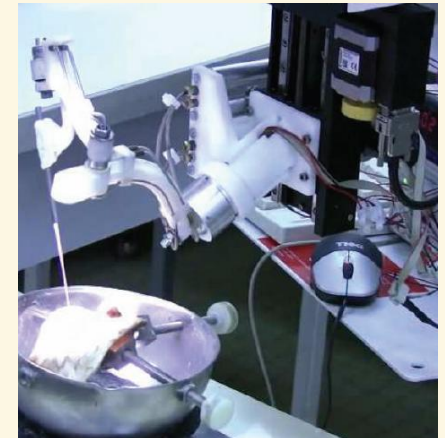
## **Steady Hand** (Johns Hopkins University)

- Parallel co-manipulation (instrument held by surgeon and robot) under microscope for intra-ocular surgery
- Active motion filtering and restriction
- Remote center-of-motion



## **RobOtol** (ISIR, UPMC-CNRS)

- On-site tele-operation under microscope for middle ear surgery
- Downscaling of gestures
- Inexpensive technology





# My research project

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**Purpose:** Downscaling of surgeon's gestures in open reconstructive microsurgery

- Increase surgical accuracy
- Facilitate surgery in deep tissue
- Allow anastomosis on sub-millimeter nerves and vascular structures



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## Constraints

- Current operating protocol
- Compact robot with large workspace
- Very high accuracy required ( $\sim 0.01$  mm)
- Surgeon close to the patient
- Minimizing the cost



# Schedule

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1. State of the art, needs analysis
2. Choice of robot topology and optimization of dimensions
3. Prototype
4. Controller and interface
5. Quantification of the performance
6. Study of different modes of interaction
7. Ex vivo and in vivo tests

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