



Rocco Moccia

Tutor: Prof. Bruno Siciliano— co-Tutor: Fanny
Ficuciello, PhD

XXXIII Cycle - I year presentation

**Visual Perception and
Autonomous Task Execution in
Robotic Surgery**



UNIVERSITÀ DEGLI STUDI DI NAPOLI
FEDERICO II

Background

PAST EXPERIENCE

Jun. 2015

Nov. 2015



Master thesis student at Human Neuromuscular Physiology Lab, Department of Applied Physiology, Georgia Institute of Technology, Atlanta (US). Supervisor: Prof. Minoru Shinohara.

Thesis topic: Improving physical Human-Robot Interaction through neuromuscular adaptive robot co-workers.

EDUCATION

Sep. 2014

Jan. 2017



MSc in Mechanical Engineering at Sapienza, Università di Roma, Department of Mechanical and Aerospace Engineering. Thesis Supervisor: Prof. Paolo Cappa.

Dissertation: Design and Development of a Haptic Human-Robot Interface to study the effect of Co-Contraction Training on human motor control.



Current Position



CURRENT POSITION

Jan. 2018
Present



UNIVERSITY OF LEEDS

Ph.D. candidate at Università degli Studi di Napoli Federico II, Department of Information Technology and Electrical Engineering, PRISMA Lab and ICAROS center. Supervisor: Prof. Bruno Siciliano. Co-Supervisor: Fanny Ficuciello Ph.D.



Fellowship: Industrial PON Ph.D. program with Medical Micro Instruments MMI S.p.A and University of Leeds: Development of the control architecture of a semi-autonomous robotic platform for microsurgery.

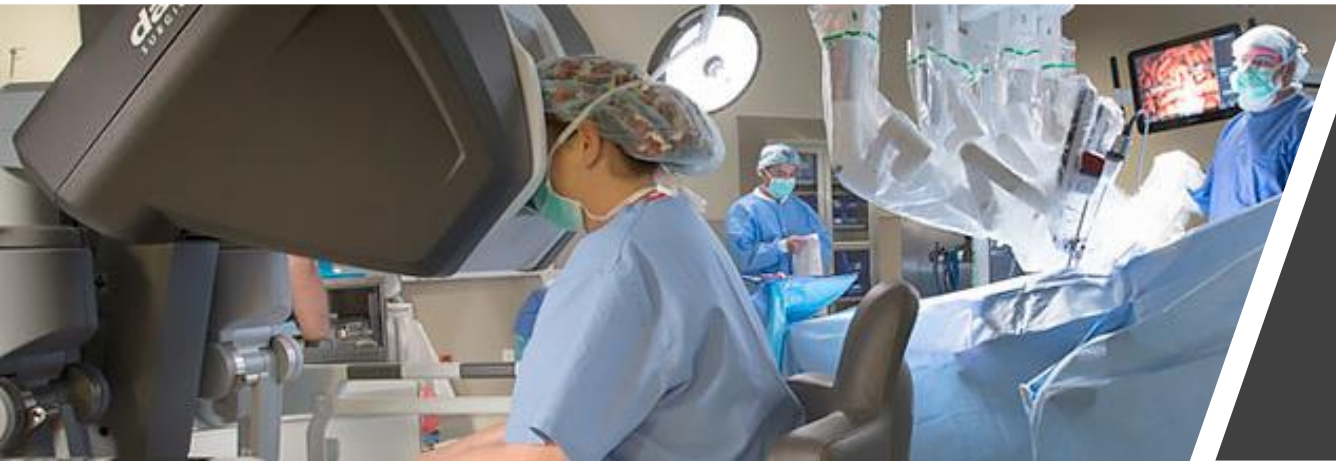




Robotic Microsurgery

Research Field

Minimally Invasive Robotic Surgery (MIRS)

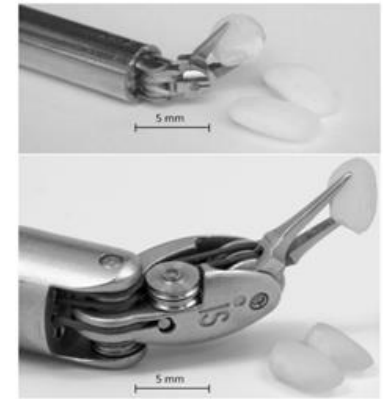


Rocco Moccia

Problem

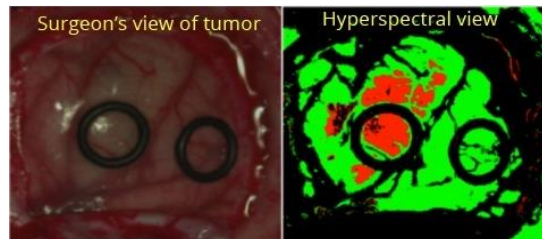
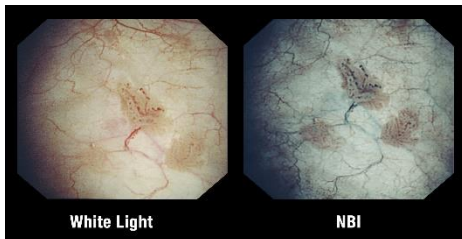
Research Topic:

- Robotics in Minimally Invasive Surgery and Microsurgery holds great potential, especially in tasks executed at limits of human capabilities:
 - **Benefits:** enhanced precision and repeatability; comfort of the surgeon; patient's outcomes
 - **Limits:** visual perception; force sensing; tools dexterity; (semi-) autonomous control



Objectives:

- Control algorithms for surgeon assistance during surgical procedures
- Stereo vision for scene detection, tracking of soft-tissues and surgical instruments
- Exploration of new visual sensing technologies: TeraHertz, Narrow band Imaging and Hyperspectral Imaging



Research Activity

Specific Problem: Tumor/Polyp Dissection

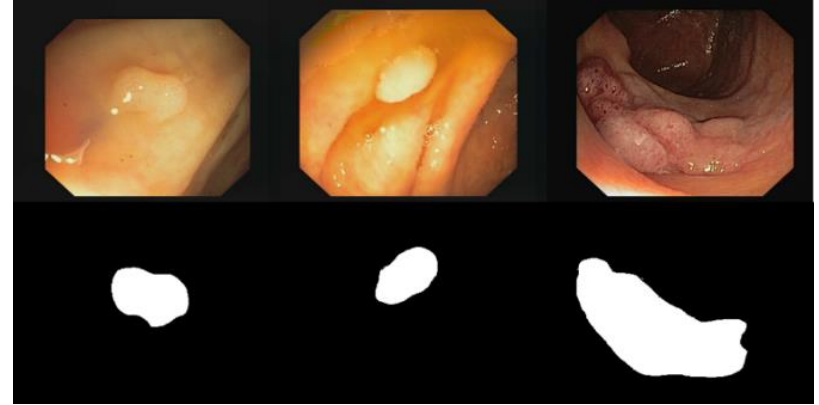
- precise movements
- high dexterity
- enhanced skills for region of interest identification and accurate path definition



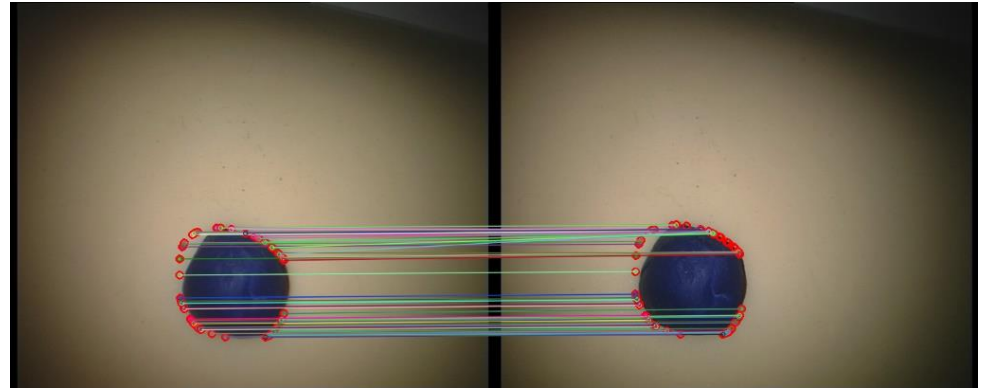
Research Activity

Methodology

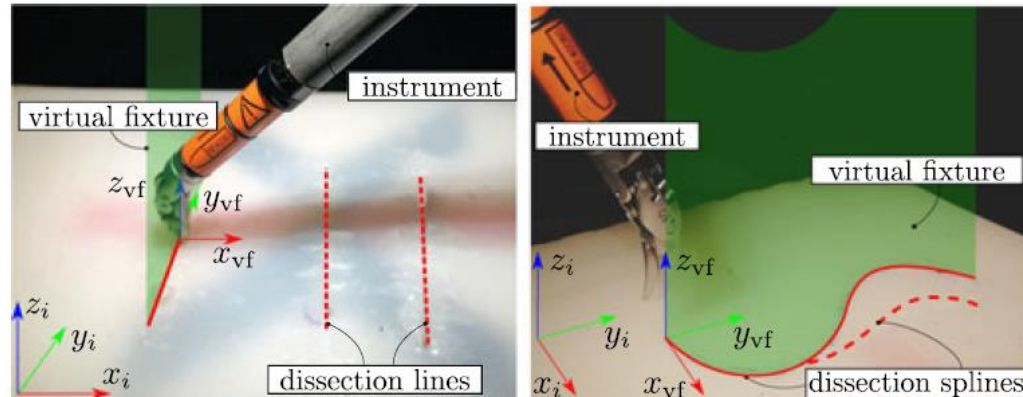
Detection and Segmentation of the polyp:
to define region of intervention



3D Reconstruction: to estimate the pose of the polyp

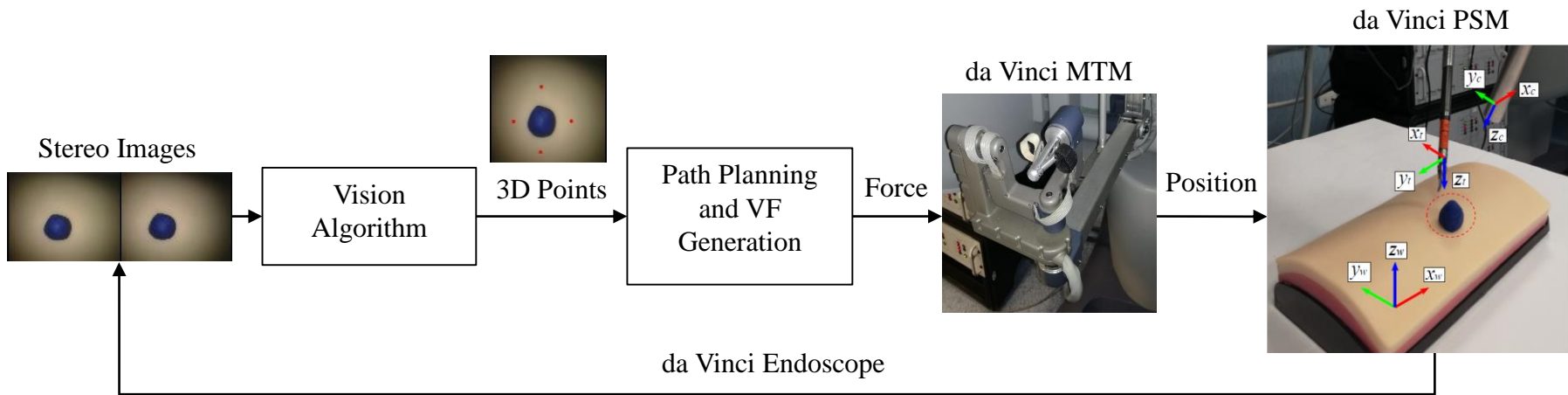


Haptic Guidance: Virtual Fixtures restrict the motion on a specific path

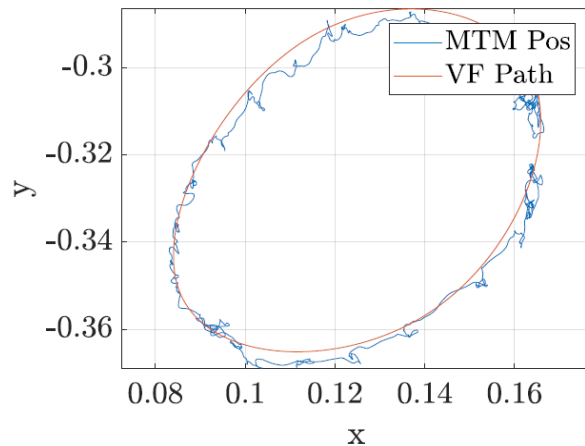


Research Activity Developments

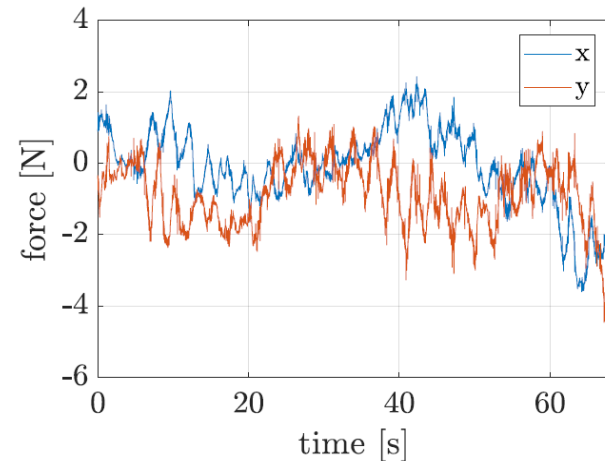
Vision-based Virtual Fixtures Generation for MIRS Dissection Task



Virtual Fixture and Robot Position



Haptic Guidance Forces



Products

Accepted Papers

- **R.Moccia**, M.Selvaggio, B.Siciliano, A.Arezzo, F.Ficuciello, “Vision-based Virtual Fixtures Generation for MIS Dissection Tasks” CRAS 2019 – 9th Joint Workshop on New Technologies for Computer/Robot Assisted Surgery, Genova, Italy, March 21-22, 2019.

Papers in Preparation (Titles are provisional)

- **R.Moccia**, M.Selvaggio, B.Siciliano, F.Ficuciello, “Vision-based Virtual Fixtures Generation for Polyp Dissection and Surgical Tools Collision Avoidance in Colon-Rectal Surgery”, in preparation.
- M.Selvaggio, **R.Moccia**, B.Siciliano, F.Ficuciello, “Autonomous Virtual Fixtures Generation and Adaptation in Minimally Invasive Surgery: A Survey”, in preparation.

Next Year

	Credits year 1								Credits year 2								Credits year 3								Total	Check
	Estimated	1 bimonth	2 bimonth	3 bimonth	4 bimonth	5 bimonth	6 bimonth	Summary	Estimated	1 bimonth	2 bimonth	3 bimonth	4 bimonth	5 bimonth	6 bimonth	Summary	Estimated	1 bimonth	2 bimonth	3 bimonth	4 bimonth	5 bimonth	6 bimonth	Summary		
Modules	20			3	3		13	19	11							0	0							0	19	30-70
Seminars	5	3,2	0,4	1			0,2	4,8	5,2							0	5							0	4,8	10-30
Research	35	5	6	6	6	6	6	35	45							0	60							0	35	80-140
	60	8,2	6,4	10	9	6	19	59	61	0	0	0	0	0	0	0	65	0	0	0	0	0	0	0	59	180

Year	Lecture/Activity	Type	Credits	Certification	Notes
	MODULES				
1	Green Economy and Management in Engineering projects	External Module	3	x	
1	Summer School on Control of Surgical Robots (COSUR 2018)	Doctoral School	3	x	
1	Image Processing For Computer Vision	MS Module	9	x	
1	Geometric Theory of Soft Robots	External Module	4	x	
	SEMINARS				
1	EIT-Health Matchmaking Event 2018	Conference	3,2	x	
1	The Age of Human-Robot Collaboration	Seminar	0,4	x	
1	IBMQ: Building the First Universal Quantum Computers for Business and Science	Seminar	0,8	x	
1	How Does Mathworks Accelerate the Pace of Engineering and Science?	Seminar	0,2	x	
1	Domains of Attraction and Manifolds in Gear Model	Seminar	0,2	x	



THANK
YOU

