Avinash Kumar Singh

Multifunctional Robot Hands

Tutor: Prof. Fanny Ficuciello

Cycle: XXXVII

Year: First

My background

- M.Sc. degree : **M.Sc. In Electrical Energy and Mobility Systems.**
- Research group/laboratory: **Interdepartmental Center for Advances in Robotic Surgery (ICAROS), Policlinico, Napoli.**
- PhD start date: **01.11.2021.**
- Scholarship type: **UNINA.**

Research field of interest

Research field of interest: **Mechanical design and sensorization of anthropomorphic multifunctional robotic hands and prosthesis.**

Summary of study activities

- Ad hoc PhD courses/schools:
  - **Ad hoc course on Neural Networks by Sant'Anna, PISA.**
  - **COSER- PhD Summer school for Commonsense reasoning in surgical robotics by Università di Verona.**
  - **2nd International Short school on Smart materials for optoelectronics applications by PULSE-COM, HORIZON-2020.**

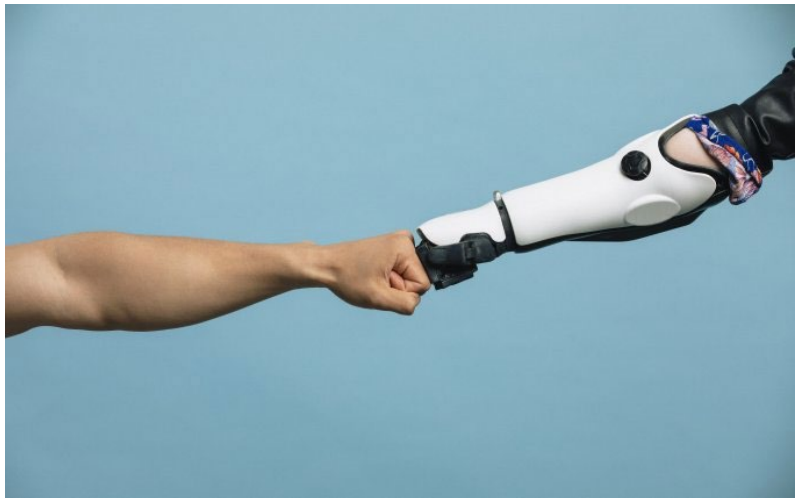
- Conferences attended:
  - **Conference on New Technologies for Computer and Robot Assisted Surgery(CRAS 2022) held in Napoli, Italy.**
  - **Italian Institute of Robotics and Intelligent Machines (I-RIM 3D 2022) held in Rome, Italy.**

Summary of study activities

- Seminars attended:
  - **The era of human robot collaboration: Deep sea exploration by Prof. Oussama Khatib, Director of Stanford Robotics Lab.**
  - **The learning landscape in deep neural networks and its exploitation by learning algorithms by Prof. Riccardo Zecchina, Department of Computing Sciences, Università Bocconi, Milano, Italy.**
  - **IEEE Authorship and Open Access Symposium: Tips and Best Practices to Get Published from IEEE Editors by IEEE.**
  - **Using Delays For Control by Prof. Emilia Fridman, School of Electrical Engineering - Tel Aviv University.**
  - **Symbiotic Control of Wearable Soft Suits for human motion assistance and augmentation by Prof. Lorenzo Masia, Chair in "Biorobotics and Medical Technology" , Heidelberg University, Germany.**
  - **Vine robots: design challenges and unique opportunities by Dr. Nicolas Naclerio by University of California Santa Barbara, USA.**
  - **Surgical Robotics by Prof Alberto Arezzo, Department of Surgical Sciences University of Turin.**
  - **Exoskeletons by Dr. Stefano Dalla Gasperina, Dr. Francesca Dell 'Eva, TU Delft, Politecnico Milano.**

Research activity: Overview

- Problems:
  - Universal Broad Problems:
    - Upper limb amputation.
    - Managing daily life activities.
    - Social Isolation.

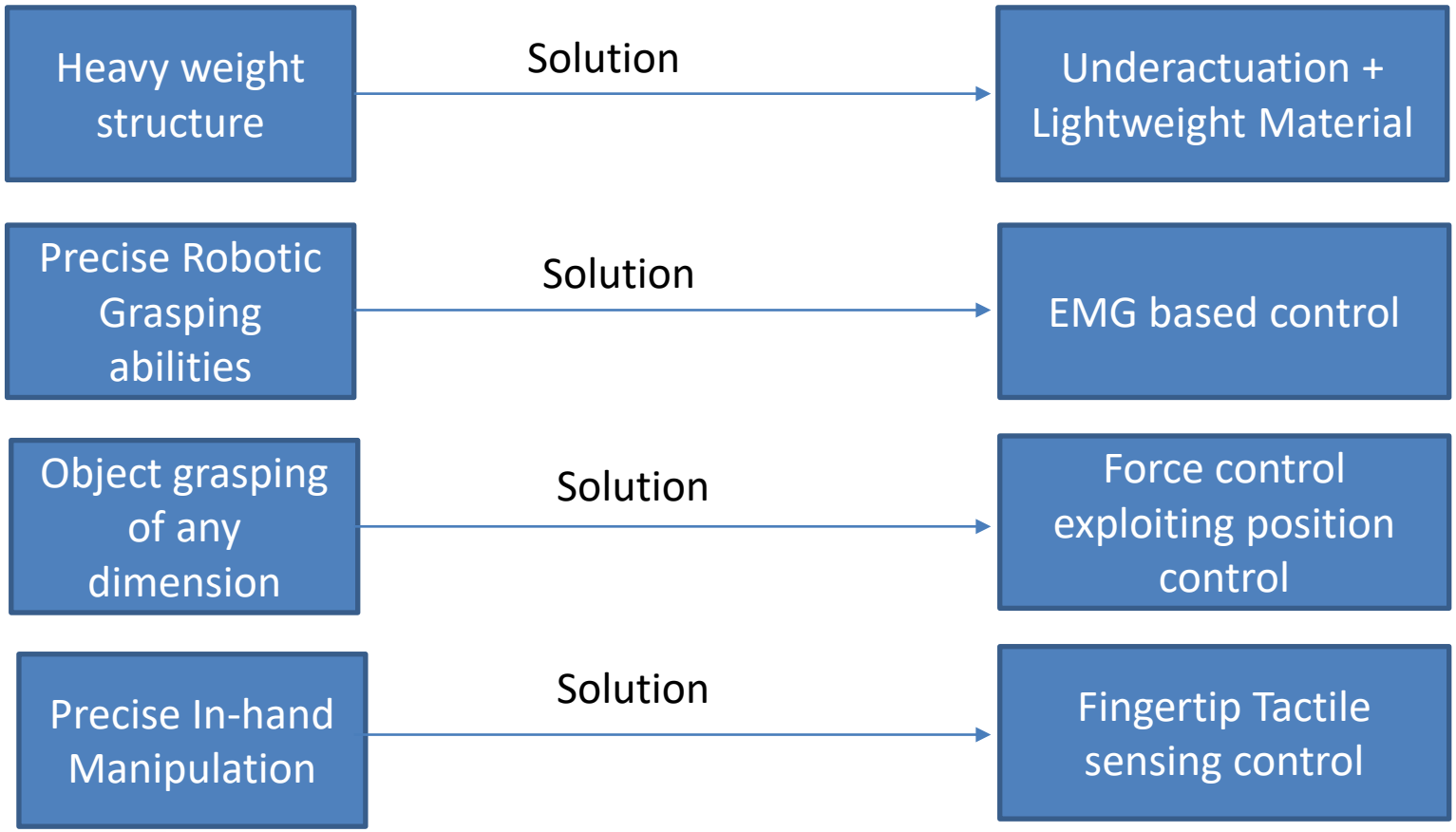


Research activity: Overview

- Problems:
  - Narrow Detailed Problems:
    - Heavyweight robotic hand structure.
    - Precise robotic grasping abilities.
    - Abilities of robotic hand to grasp objects of any orientations.
    - Precise In-hand Manipulation after successful grasps.

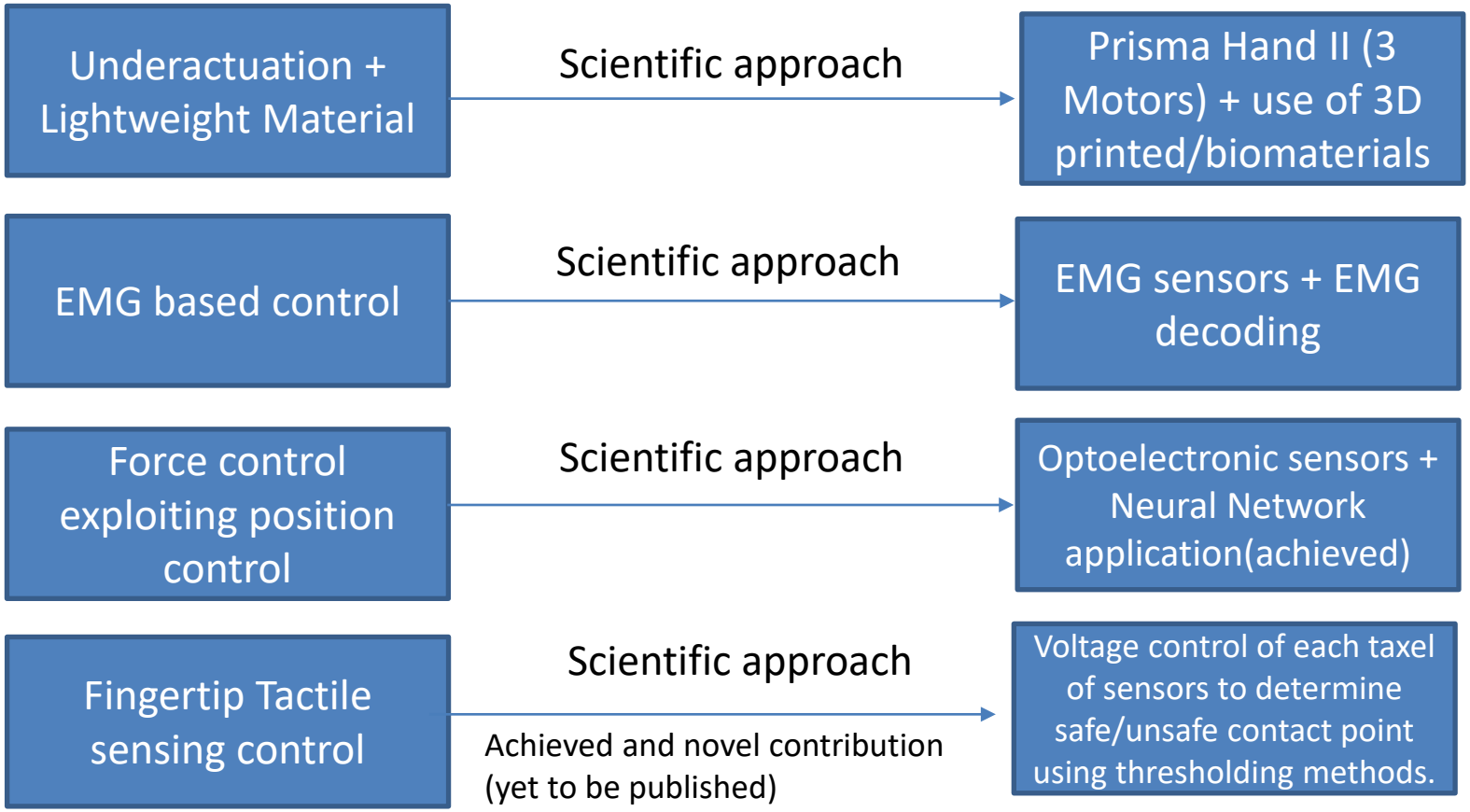
Research activity: Overview

- Problems and Solutions:



Research activity: Overview

- Methodology:



Products

[P1]	**Participation and winner of 5th position in Start cup Campania for Prisma Hand II.**
[P2]	**<u>Paper accepted for IRIM 2022 conference</u>:** An optimized tactile sensing technology built for an anthropomorphic robotic hand by Avinash Kumar Singh, Petros Kaltsas, Fanny Ficuciello
[P2]	**<u>Journal under review for IEEE Robotics and Automation Letters (RA-L):</u>** In-hand manipulation with an anthropomorphic robot hand using a combination of reconstructed forces and raw data from an optimized tactile sensing technology by Avinash Kumar Singh, Massimiliano Pinto, Petros Kaltsas, Salvatore Pirozzi, Fanny Ficuciello.

Next Year Vision

- **Optimisation in construction of Prisma Hand structure** with advanced and lightweight materials.
- **Utilisation of all 5 fingertip sensors for enhanced in-hand manipulation and force control + Slip detection** (Possibility for application of Discrete wavelength transformation [DWT] or covariance methods or relative algorithms.)
- **Precise EMG decoding methods to move the hand** using EMG sensors (Exploration of neural network application to predict the movements.)
- **Construction of a prosthetic wrist and socket** compatible with Prisma Hand II.

Thank you for listening!