Nicola A. Piga

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Who I am

I am a *PhD candidate* in *humanoid robotics* with a background in *automation* and *robotics engineering*. My research deals with the development of *6D object pose tracking* algorithms for humanoid robots that combine neural networks, Bayesian filtering, vision and tactile sensing.

Facts about me

- Researcher in humanoid robotics with a passion for state estimation applied to 6D object pose tracking.
- Enthusiast Linux and C++ user.
- Hardware experience with several humanoid and industrial robotic platforms.
- Main interests: Bayesian filtering, 6D object pose tracking, Machine learning-aided object tracking, Tactile sensing.

Current Position

November, 2021 - current — **PhD candidate @ Humanoid Sensing and Perception (Istituto Italiano di Tecnologia)**, *Istituto Italiano di Tecnologia*, Genova, Italy.

Publications

2021 **ROFT: Real-Time Optical Flow-Aided 6D Object Pose and Velocity Tracking** , ***Piga, N.***, *Onyshchuk Y., Pasquale G., Pattacini, U. and Natale, L.*, IEEE Robotics and Automation Letters, vol. 7, no. 1, pp. 159-166, Jan. 2022

2021 **A Differentiable Extended Kalman Filter for Object Tracking Under Sliding Regime**, ***Piga, N.***, *Pattacini, U. and Natale, L.*, Frontiers in Robotics and AI, Humanoid Robotics, Vol. 8, Pg. 251, 2021.

2021 **Active Perception for Ambiguous Objects Classification**, *Safronov, E.*, ***Piga, N.***, *Colledanchise, M. and Natale, L.*, Accepted at 2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2021).

2021 **MaskUKF: An Instance Segmentation Aided Unscented Kalman Filter for 6D Object Pose and Velocity Tracking**, ***Piga, N.***, *Bottarel, F., Fantacci, C., Vezzani, G., Pattacini, U. and Natale, L.*, Frontiers in Robotics and AI, Humanoid Robotics, Vol. 8, Pg. 38, 2021.

2019 **Magnetic 3-axis Soft and Sensitive Fingertip Sensors Integration for the iCub Humanoid Robot**, *Holgado, A. C.*, ***Piga, N.***, *Pradhono Tomo, T., Vezzani, G., Schmitz, A., Natale, L. and Sugano, S.*, Proc. IEEE-RAS International Conference on Humanoid Robotics, Toronto, Canada, 2019.

Skills

Software
Programming languages, C++, Python.
Libraries, Eigen, OpenCV, VTK, YARP, ROS.
Simulators, Gazebo.
OS, Linux, Windows.
Build systems, CMake.
Version control systems, Git.

Hardware
Robots, iCub humanoid robot, Franka Emika Panda, RGB-D sensors, Tactile sensors (capacitive, magnetic-based, vision-based).

Soft skills
Work-related, Problem solving, Teamwork, Leadership, Motivation.
Languages, English (independent user), Italian (mother-tongue).

Past Experience

November, 2018 - November, 2021
PhD student @ Humanoid Sensing and Perception (Istituto Italiano di Tecnologia), *Istituto Italiano di Tecnologia*, Genova, Italy.

I carried out my PhD in Advanced and Humanoid Robotics at the Humanoid Sensing and Perception research line at Istituto Italiano di Tecnologia in Genova. During the PhD project, I developed hybrid architectures for 6D object pose tracking by fusing Deep Learning with Kalman filtering techniques. Part of my work was dedicated to the development of these algorithms in C++ and their testing on the iCub humanoid platform using vision and tactile sensors.

December 2017 - September 2018
Research Fellow @ Humanoid Sensing and Perception (Istituto Italiano di Tecnologia), *Object localization using vision and touch: experiments on the iCub humanoid robot*, Istituto Italiano di Tecnologia & Università di Pisa, Genova, Italy.

During my M. Sc. thesis in collaboration with Istituto Italiano di Tecnologia (IIT), I designed a Bayesian object localization algorithm for the robot iCub exploiting visual and tactile measurements.

July 2017
***Easy Peasy Robotics Coding Workshop* at Campus Party Italia**, *Milan*, Italy.
Two-days crash course about humanoid robot programming offered by the Istituto Italiano di Tecnologia. The course was organized as a set of lectures on robot control, robot vision and software architectures for robot programming followed by hands-on sessions using the simulator as well as a real iCub head.

September, 2010 - November, 2010
Internship at Connect.ie, Ireland.
Development of websites for european projects.

Education

December, 2014 - September, 2018
M. Sc. with full honours in Robotics and Automation Engineering, *Università di Pisa*, Pisa, Italy.

M. Sc. Thesis "Object localization using vision and touch: experiments on the iCub humanoid robot"

I developed a Bayesian filtering algorithm for object localization that uses visual and tactile information in the form of Cartesian points belonging to the surface of the object. To this end, I extended the state-of-the-art Memory Unscented Particle Filter algorithm for tactile localization of a stationary object in order to localize an object using visual measurements, in the form of point clouds, and track its pose using tactile measurements while the object is manipulated by an external end-effector. The algorithm was tested in simulation using the Gazebo simulator and on the iCub humanoid robot using its stereo vision and tactile sensing systems.

M. Sc. Projects:

- "Design and implementation of an Auto-Ranging mechanism for the DecaWave EVB1000 indoor localization system".
- "Design and implementation of a hybrid position/force controller for the KUKA LWR4+ manipulator equipped with a Pisa/IIT SoftHand in order to grasp thin objects exploiting safe hand-environment interactions".
  Video: https://youtu.be/0tVq7SOc8s8.
  C++ implementation: https://git.io/vdVYE.
- "Robust Control of a Double Mass Spring Damper system".
- "Real time simulation of several flying 2D quadrotors each controlled along a user-defined trajectory using a LQG control system".
- "Simultaneous cooperative object localization and transport with several iRobot Create 2 robots in the Gazebo simulator".
  Python implementation: https://git.io/v9KMv
- "Measurement, transmission and representation of the attitude of a 3DoF mechanical system".

September, 2011 - December, 2014

B. Sc. with full honours in Computer Engineering, *Università di Pisa*, Pisa, Italy.

B. Sc. Thesis "Analysis of the reconstruction error in environmental monitoring via Compressive Sensing"

I implemented a Compressive Sensing algorithm for the collection of environmental data and I carried out an analysis in order to compare the reconstruction error obtained with standard Nyquist based sampling techniques. The algorithm was tested with real measurements acquired using an Autonomous Weather Station.