Arnaud **Tanguy**

Research Engineer · Robotics

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Experience

University of Montpellier – LIRMM – BIATSS

Montpellier, France

Research Engineer — *Feb. 2024 – Feb. 2025*

- Maintainer of the control framework mc_rtc
- Development and maintenance of LIRMM's robotic platforms, notably humanoid robots (HRP-4, RHPS1, Unitree G1) and robotic arms (Franka Emika Panda, Universal Robots).
- Rollkneematics project: Prototyping a new capacitive sensor for knee prosthesis detection in collaboration with BoneTag.
- Development of reproducible demonstrators: dance HRP-4, RHPS1, whole-body dynamic stability control of a humanoid, etc.
- Support and development for projects of all LIRMM robotics teams, notably humanoid and underwater.
- 3D part modeling and printing: sensor integration, mechanical adaptations, etc.

CNRS – LIRMM – Interactive Digital Human

Montpellier, France

Research Engineer — *Nov. 2021 – April 2023*

- Development of the mc_rtc framework
- Creation of industrial demonstrators (*confidential*)
- Participation in the I.AM project
- Prototyping a new capacitive sensor for knee prosthesis detection in collaboration with BoneTag.
- Supervision and support for PhD students and postdocs
- Finalist in the international competition X-Prize as part of the Janus team

Joint Robotics Laboratory – Advanced Institute of Science of Technology

Tsukuba, Japan

Research Engineer — *Nov. 2019 – April 2021*

- Responsible for the unification and merging of control software between :
  – The mc_rtc framework developed by CNRS by the IDH team at LIRMM (Montpellier) and AIST-JRL (Tsukuba)
  – The HMC framework developed by the HRG group at AIST (Tsukuba)
- Technical support for both groups, development of demonstrations on robots to ensure experimental contributions to scientific publications as well as to meet the expectations expressed by the many bilateral projects with industry partners.

CNRS – LIRMM – Interactive Digital Human

Montpellier, France

Research Engineer — *Oct. 2018 - Oct. 2019*

- H2020 COMANOID - Multi-Contact Collaborative Humanoids in Aircraft Manufacturing
  Site: `https://comanoid.cnrs.fr/`
  Role: **Responsible for the implementation and integration of localization and mapping methods** for the final demonstration of the European COMANOID project. This demonstration, the result of 4 years of joint effort between four research institutes (LIRMM, DLR, University of Rome La Sapienza, Inria Rennes and Grenoble) demonstrated the applicability of manufacturing humanoid robots in the real industrial context of aircraft construction. This mainly involved locomotion and manipulation capabilities in a constrained space: walking and localization (SLAM), stair climbing (MPC), manipulation (SLAM, registration, visual servoing, force control, etc.).
- mc_rtc: `https://jrl-umi3218.github.io/mc_rtc`
  Development and maintenance of the control framework `mc_rtc` used in the above demonstrator, as well as by students and researchers at LIRMM, JRL, and their partners.
- Technical support for IDH students and researchers and conducting experiments on HRP-4 and BAZAR robots.

LIRMM, I3S, JRL

France, Japan

PhD

Oct. 2014 - Nov. 2018

- Supervisors: Abderrahmane Kheddar, Andrew Comport
- Projects: RobotHow, H2020 COMANOID, DARPA Robotics Challenge
- Localization of a humanoid robot and its environment using state-of-the-art dense visual SLAM.
- Object localization by registering CAD models with the dense SLAM map.
- Online adaptation of offline-generated multi-contact locomotion plans using SLAM-based localization and mapping.
- Development of a whole-body calibration method.
- Walking by model predictive control (MPC), using a fusion of visual (SLAM) and proprioceptive (encoders, force sensors) information to react to disturbances by continuously generating a ZMP trajectory and future steps ensuring the robot's stability.
- *DARPA Robotics Challenge (DRC)*: Participation as part of the AIST-NEDO team. Ranked 10/23 with completion of 6 out of 8 tasks (semi-autonomous driving, opening a door and a valve, drilling a wall, connecting a cable, traversing rough terrain).
- Software contributions
  - Registration methods used during the DARPA Robotics Challenge: 3D point cloud registration (`https://github.com/arntanguy/icp`), generation of 3D point clouds from their CAD models (`https://github.com/arntanguy/mesh_sampling`)
  - Savitzky-Golay filter – `https://github.com/arntanguy/gram_savitzky_golay`
  - Whole-body calibration – `https://github.com/arntanguy/robcalib`
  - Contributions to `mc_rtc`: state observation (SLAM, IMU, VICON ground truth,...), trajectory tracking tasks, etc.

Technische Universität München (TUM)

Munich, Germany

Intern

2014 (6 months)

- Supervisors: Jurgen Sturm and Daniel Cremers
- Application of convolutional neural networks to loop closure detection in SLAM.
- Development of the architecture enabling the use of Siamese networks in the open-source framework `Caffe`.

Polytech Nice-Sophia-Antipolis, Trinity College Dublin

France, Ireland, Germany

University projects

2014 (6 months)

- Development of a physics and rendering engine (fluid simulation, rigid body collisions, object/fluid collisions, raytracing) `https://github.com/arntanguy/PHEngine`.
- Development of an interactive curve fitting software specialized for research in scanning tunneling microscopy spectroscopy `https://github.com/arntanguy/STS-simulator`.
- Photorealistic rendering of SLAM maps in an Occulus Rift (project led by Andrew Comport).
- Development of a 3D racing game for visually impaired players `http://prdevint.polytech.unice.fr`.
- Development of augmented reality games.

Fotowall

Brest, France

High school student, self-taught C++ project

2008-2011

- Site: `https://www.enricoros.com/opensource/fotowall/index.html`
- Self-taught development of the open-source C++ image manipulation software Fotowall
- Remote collaboration with the Italian developer Enrico Ross
- Over one million downloads (as of 2017)

Education

University of Montpellier. Joint Research Units: LIRMM, I3S, JRL

Montpellier, Nice, Tsukuba

PhD in Humanoid Robotics and Computer Vision, University of Montpellier

Oct. 2014 – Nov. 2018

- Title: "Visual SLAM for localization and closed-loop control of humanoid robots"
- Keywords: Dense visual SLAM; localization; state estimation; multi-contact planning and control; whole-body calibration; quadratic programming; model predictive control.
- Supervisors: Abderrahmane Kheddar, Andrew Comport
- Thesis carried out within three CNRS joint research units:
  – LIRMM, Montpellier, France – *Laboratory of Computer Science, Robotics and Microelectronics of Montpellier (LIRMM), Interactive Digital Human (IDH) Team*
  – I3S, Sophia-Antipolis, France – *Laboratory of Computer Science, Signals and Systems of Sophia Antipolis, Signal, Images and Systems (SIS) Team*
  – CNRS-AIST JRL, Tsukuba, Japan – *Advanced Institute of Science and Technology (AIST), Joint Robotics Laboratory (JRL)*

University of Nice, Polytech Nice-Sophia Antipolis

Nice, France

Engineering Degree in Computer Science, Master's Level

Sept. 2011 - Sept. 2014

- Specialization in image vision and multimedia
- Trinity College Dublin, 2012-2013: ERASMUS year, Master's in Interactive Technologies
- Technische Universität München, 2014: 6-month internship – place recognition using convolutional neural networks.

Lycée de Kerichen

Brest, France

Preparatory Classes for Grandes Écoles, Mathematics, Physics and Engineering Science (MPSI)

Sept. 2009 - June. 2011

Publications

Journal Articles

Humanoid Loco-Manipulations Pattern Generation and Stabilization Control

M. Murooka, K. Chappellet, A. Tanguy, M. Benallegue, I. Kumagai, M. Morisawa, F. Kanehiro, A. Kheddar

IEEE Robotics and Automation Letters (RA-L), 2021

Humanoid Control Under Interchangeable Fixed and Sliding Unilateral Contacts

S. Samadi, J. Roux, A. Tanguy, S. Caron, A. Kheddar

IEEE Robotics and Automation Letters, IEEE, 2021

Online Object Searching by a Humanoid Robot in an Unknown Environment

M. Tsuru, A. Escande, A. Tanguy, K. Chappellet, K. Harada

IEEE Robotics and Automation Letters, IEEE, 2021

Adaptive-Gains Enforcing Constraints in Closed-Loop QP Control

M. Djeha, A. Tanguy, A. Kheddar

IEEE Robotics and Automation Letters (RA-L), 2020

Impact-Aware Task-Space Quadratic-Programming Control

Y. Wang, N. Dehio, A. Tanguy, A. Kheddar

The International Journal of Robotics Research (submitted), 2020

Humanoid robots in aircraft manufacturing

A. Kheddar, S. Caron, P. Gergondet, A. Comport, A. Tanguy, C. Ott, B. Henze, G. Mesesan, J. Englsberger, M. A. Roa, P.-B. Wieber, F. Chaumette, F. Spindler, G. Oriolo, L. Lanari, A. Escande, K. Chappellet, F. Kanehiro, P. RABATE

IEEE Robotics and Automation Magazine, Institute of Electrical and Electronics Engineers, 2019, **best paper award**

Conference Proceedings

Task-Space Control Interface for SoftBank Humanoid Robots and its Human-Robot Interaction Applications

A. Bolotnikova, P. Gergondet, A. Tanguy, S. Courtois, A. Kheddar

IEEE/SICE 13th International Symposium on System Integration (SII 2021), 2021, Online conference (originally: Iwaki, Fukushima), Japan

Vision-based Belt Manipulation by Humanoid Robot

Y. Qin, A. Tanguy, A. Escande, E. Yoshida

IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2020

Balance of Humanoid robot in Multi-contact and Sliding Scenarios

S. Saeid, S. Caron, A. Tanguy, A. Kheddar

IEEE International Conference on Robotics and Autonmation (ICRA), 2020

Online Object Searching with Humanoid Robot by 3D-SLAM and 6DoF Object Detection

M. Tsuru, A. Tanguy, K. Harada, A. Escande

The Robotics and Mechatronics Conference, 2020

Impact-aware humanoid robot motion generation with a quadratic optimization controller

Y. Wang, A. Tanguy, P. Gergondet, A. Kheddar

IEEE Humanoids, 2019, Toronto, Canada

Closed-loop MPC with Dense Visual SLAM-Stability through Reactive Stepping

A. Tanguy, D. De Simone, A. I. Comport, G. Oriolo, A. Kheddar

IEEE International Conference on Robotics and Autonmation (ICRA), 2018

Online eye-robot self-calibration

A. Tanguy, A. Kheddar, A. I. Comport

2018 IEEE International Conference on Simulation, Modeling, and Programming for Autonomous Robots (SIMPAR), 2018, Brisbane, Australia

Closed-loop RGB-D SLAM Multi-Contact Control for humanoid robots

A. Tanguy, P. Gergondet, A. I. Comport, A. Kheddar

IEEE/SICE International Symposium on System Integration (SII), 2016, Sapporo, Japan, **best paper finalist award**

Extracurricular Activities

Fédération française des clubs alpins et de montagne (FFCAM) — *France*

Head of Mountaineering Section — *2022-Present*

Fédération française des clubs alpins et de montagne (FFCAM)

France

Climbing Instructor

2019-Present

- Ice climbing and trad climbing instructor
- Member of the Occitanie Mountaineering Hopefuls Group

Conservatory of Music and Dramatic Arts

Brest, France

Diploma of Completion in Music Studies (CFEM) in Oboe

10 years