



Arnaud Tanguy

ROBOTICS RESEARCH ENGINEER

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Research Engineer with over eight years of experience working with state-of-the-art humanoid robots and computer vision to solve real-world problems

Education

PhD in Humanoid Robotics and Computer Vision

Montpellier, Nice, Tsukuba

UNIVERSITY DE MONTPELLIER, LIRMM, I3S, JRL

Oct. 2014 – Nov. 2018

- **TITRE** : “Visual SLAM for Localization and Closed-loop Control of Humanoid Robots”
- **RESEARCH DIRECTORS** : Abderrahmane Kheddar, Andrew Ian Comport
- **PROJECTS**: RobotHow, H2020 COMANOID, DARPA Robotics Challenge
- Localization of a humanoid robot and its environment using state-of-the-art Dense Visual Simultaneous Localization and Mapping (SLAM)
- Localizing objects by registering CAD models onto the dense map of SLAM
- Online adaptation of multi-contact locomotion plans (previously generated offline) to the observed shape of the environment
- Developpement of a whole-body self-calibration method using only vision and on-board sensors
- Walking with Model Predictive Control (MPC) by taking advantage of the fusion of visual informations (SLAM) and proprioceptive sensors (encoders, force sensors). This method allows to react to external perturbations by continuously generating a feasible trajectory of the Zero-Moment-Point (ZMP) and corresponding footsteps to ensure the robot's stability.
- **DARPA Robotics Challenge (DRC)**: Participated as part of team AIST-NEDO. Responsible for computer vision and in particular localization of objects. Ranked 10/23 with the successful realization of 6 out of 8 tasks (supervised autonomous driving, door opening, valve closing, wall drilling, cable plugging, crossing a debris field and finally climbing stairs).
- **SOFTWARE CONTRIBUTIONS**
 - Registration methods used during the DRC challenge: CAD to Point Cloud registration using ICP (<https://github.com/arntanguy/icp>) and generation of 3D point clouds from CAD models (https://github.com/arntanguy/mesh_sampling)
 - Savitzky-Golay filtering implementation (https://github.com/arntanguy/gram_savitzky_golay)
 - Whole-body calibration (<https://github.com/arntanguy/robcalib>)
 - Contributions to the `mc_rtc` framework: state observation (SLAM, IMU, ground truth VICON,...), trajectory tracking tasks, etc.

Master degree – Computer Vision and Interactive Entertainment Technologies

Nice, France

UNIVERSITY OF NICE, POLYTECH NICE-SOPHIA ANTIPOLIS

Sept. 2011 - Sept. 2014

- TRINITY COLLEGE DUBLIN, 2012-2013 : ERASMUS exchange program
- TECHNISCHE UNIVERSITÄT MÜNCHEN, 2014 : 6 months research internship on place recognition with convolutional neural networks

Classes préparatoires aux grandes écoles, Maths, Physics and Engineering Sciences

Brest, France

LYCÉE DE KERICHEN

Sept. 2009 - June. 2011

Preparation for national competitive entrance exams to leading French “grandes écoles”, specializing in mathematics and physics

Skills

Programming	C++ (17), CMake, Python, OpenGL, CUDA, Qt, Gitlab CI, Github actions
Robotics	mc_rtc framework, ROS, real-time control, task-space control with quadratic programming (QP), model predictive control (MPC), SLAM, visual servoing, force control
Robots	Full-scale humanoid robots: HRP-4, HRP-2Kai, HRP-5P, Talos, NAO, Pepper ; Manipulators: Panda (Franka Emika), Sawyer, Kukka
Languages	French (native), English (bilingual), German (intermediate), Japanese (beginner)

Work Experience

Research Engineer – Humanoid Robotics

Montpellier, France

CNRS – LIRMM – INTERACTIVE DIGITAL HUMAN

Nov. 2022 – Present

- Developpement of the `mc_rtc` robotics framework
- Industrial demonstrators for large-scale manufacturing (*confidential*)
- IAM H2020 research project on exploiting intentional robot-environment impacts for manipulation
- Prototyping of a novel capacitive sensor aiming at the real-time estimation of the position and orientation of in-patient knee prosthesis in collaboration with BoneTag
- Finalist at the ANA AVATOR X-PRIZE teleoperation contest as part of team JANUS (<https://www.xprize.org/prizes/avatar>)
- Mentorship of PhD students

Research Engineer – Humanoid Robotics

Tsukuba, Japan

JOINT ROBOTICS LABORATORY – ADVANCED INSTITUTE OF SCIENCE OF TECHNOLOGY

Nov. 2019 – April 2021

- Responsible for the unification of two large-scale robotics frameworks:
 - The `mc_rtc` framework developed by CNRS, the IDH team in LIRMM (Montpellier) and AIST-JRL (Tsukuba)
 - The HMC framework developed by the HRG group in AIST (Tsukuba)
- Responsible for technical demonstrations on full-scale humanoid robots (HRP-5P, HRP-2Kai, HRP4)
- Providing mentorship and technical support to PhD students

Research Engineer – Humanoid Robotics

Montpellier, France

CNRS – LIRMM – INTERACTIVE DIGITAL HUMAN

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 real-time localization and mapping** for the final demonstration of the H2020 COMANOID European project. This demonstrator is the end result of 4 years of efforts shared between four leading research institutes (LIRMM, DLR, University of Rome La Sapienza and INRIA Rennes/Grenoble). It showcased the ability of humanoid robots to handle real manufacturing use-cases in aeronautic construction. Challenges involved locomotion and manipulation in a constrained environment, walking and localization (SLAM), stair climbing (Model Predictive Control), manipulation (SLAM, visual servoing, object registration, force control, etc.).
- MC_RTC: https://jrl-umi3218.github.io/mc_rtc
Developpement of the `mc_rtc` control framework used by the aforementioned demonstrator, as well as by students and researches of LIRMM, JRL, and their partners.
- Providing mentorship and technical support to PhD students

Deep-learning Internship

Munich, Germany

TECHNISCHE UNIVERSITÄT MÜNCHEN (TUM)

2014 (6 months)

- SUPERVISORS: Jurgen Sturm et Daniel Cremers
- Seeking to solve the loop-closure problem of visual SLAM (recognizing when a camera is looking at an already visited part of the environment) using convolutional neural networks.
- Integration of Siamise network architecture within the open-source framework **Caffe**

University Projects

France, Ireland, Germany

POLYTECH NICE-SOPHIA-ANTIPOLIS, TRINITY COLLEGE DUBLIN

2014 (6 months)

- Developpment of a physics and rendering engine (fluid simulation, rigid body collisions, raytracing)
<https://github.com/arntanguy/PHEngine>
- Developpement of an interactive curve-fitting software for scanning-tunnelling microscopy
<https://github.com/arntanguy/STS-simulator>
- Photo-realistic rendering of visual SLAM maps within a VR headset (Oculus Rift)
- Developpement of a 3D racing game for visually deficient players
<http://prdevint.polytech.unice.fr>
- Developpement of augmented reality games

Self-taught C++ project during highschool

Brest, France

FOTOWALL

2008-2011

- WEBSITE: <https://www.enricoros.com/opensource/fotowall/index.html>
- Self-taught C++ developpement and contributing to the open-source image manipulation software Fotowall
- More than a million downloads (as of 2017)

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

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

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 Automation (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 Automation (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 (SIMPAP), 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**

Hobbies

Responsible for the Mountaineering Section

FRENCH FEDERATION OF ALPINE AND MOUNTAIN CLUBS OF MONTPELLIER (FFCAM)

France

2022-Present

Climbing instructor

FRENCH FEDERATION OF ALPINE AND MOUNTAIN CLUBS (FFCAM)

- Ice climbing instructor, Traditional climbing instructor
- Member of a selective regional mountaineering team (Groupe Espoir Occitanie)

France

2019-Present

End of musical studies diploma (CFEM) in Oboe

CONSERVATOIRE DE MUSIQUE ET D'ARTS DRAMATIQUES

Brest, France

10 years