

Progetti di Sistemi Intelligenti

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Progetti completati



- Fuzzy controllers and FSM for NPC (Non-playable characters) in video-games
- Confronto di regressori (lasso e linear) per un problema di discriminazione: impatto degli iper-parametri.
- Capsule network: analisi, implementazione e valutazione
- Esplorazione iniziale di Algoritmi PPO per reinforcement learning: analisi, implementazione e valutazione.
- Profilazione di utenti (e.g. studenti) attraverso algoritmi di clustering
- Applicazione di algoritmi genetici al problema dello zaino: preparazione di un numero massimo di panini in un'osteria virtuale.
- Implementazione di un avatar che giochi autonomamente giochi archive: (e.g. snake, pong, space invaders), utilizzando fuzzy system, RL,...
- Avatar emotivi: generazione di un repertorio di comportamenti (voce, colore, gesti) associati a diversi stati emotivi.
- Il filo di Arianna: avatar che deve trovare l'uscita di un labirinto, uccidendo mostri e raccogliendo tesori.
- Generazione automatica di storie utilizzando il modello di Propp.
- On the field insects classification through Deep Neural Networks.
- Generazione di alberi mediante grammatica di Lindenmayer.
- Realizzazione di una macchina di Turing.
- Naive Bayes per rilevazione di messaggi di SPAM
- Utilizzo di SOM per realizzare terreni di stile diverso

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PPO for Reinforcement Learning



Proximal policy adaptation

A popular, on-policy reinforcement learning algorithm that improves training stability and efficiency by limiting, or "clipping," how much a policy can change in one step. Developed by OpenAI in 2017, it balances performance and simplicity, making it the default choice for various tasks, including robotic control, games, and Large Language Model (LLM) alignment.

A video can be found here:
https://www.google.com/search?q=PPO+reinforcement+learning&aq=PPO+reinforcement+learning&gs_lcrp=EgZjaHJvbWUyCQgAEEUYORiABDIICAEQABgWGB4yCAgCEAAyFhgeMgglAxAAGBYHjIIICAQABgWGB4yCAgFEAAyFhgeMggIBhAAGBYHjIIICAcQABgWGB4yCAgIEAAyFhgeMggICRAAGBYHtIBCDQwNzhqMGo3qAIAAsAIA&sourceid=chrome&ie=UTF-8#fpstate=ive&vld=cid:dbb05c0e,vid:8jtAzxUwDj0,st:0

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Emotional Nao



- Sviluppo di un robot empatico mediante diversi progetti.
 - Use case: **teacher for dancing**: integration of covert emotion transmission: gestures, colors, voice.
 - Use case: giochi da tavolo classici giocati con NAO. **Realizzazione di pedine smart** (Stampante 3D + sensori) che possano essere mosse da NAO in modo autonomo. Sviluppo di un'intelligenza di gioco.





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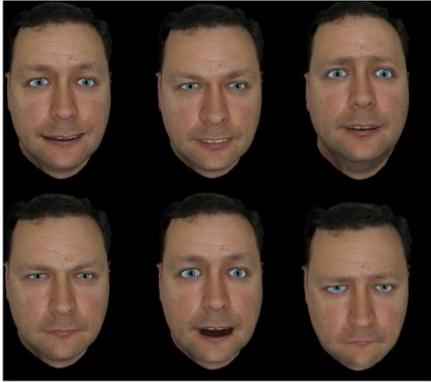


HMD and emotional state



In collaboration with PONG laboratory.

- 1) Develop adequate predictive models of the stress level and the emotional state of a player from multi-dimensional data acquired through a HMD.
- 2) Produce an emotional intelligent control of an avatar that exploits multi-media clues both covert and overt to convey emotional state.




For more information: S. Brambilla, G. Boccignone, N.A. Borghese, .L.A. Ripamonti Stress Assessment in Virtual Reality Horror Games. Using Players' Behavioural and Physiological Data. *IEEE Trans. On Games*, 2026. i.it

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Augmented reality::freezing





Study of freezing in Parkinson patients

Navigation in narrow spaces



For more information: E Chitti, DA Montereale, A De Sandi, E Mailland, L Borrellini, F Cogiamanian, D Mellace, A Marfoli, C Campo, C Manzoni, R Ferrucci and NA Borghese. *Co-design of a Mixed Reality application to support Freezing of Gait Rehabilitation*. Proc. of IEEE Segah 2025 Conference.

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Agro-robotics



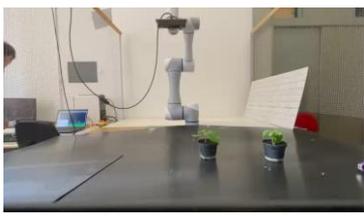
Background

- Autonomous mobile robots are valuable tools in precision agriculture

Example applications:

- Crop sensing and monitoring
- Robotic harvesting





Focus of this project/thesis:

- Robotic vision for the identification of fruits/vegetables in field or greenhouses coltures
- Motion planning algorithms for robotic manipulators:
- Active sensing by means of view planning
- Intervention in proximity

• In collaboration with the department of Agricultural sciences

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Pattugliamento agricolo





Perlustrazione di campi per early detection dell'esplosione degli infestanti di colture.

Pianificazione intelligente della perlustrazione in funzione di informazioni a-priori raccolte (storia passata, umidita', segnali precoci...)

In collaborazione con il dipartimento di agraria

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Computer Vision Applications in Robotics



Autonomous navigation is one of the most important features for deploying robots in real world

Application of deep-learning computer-vision methods to robotic-vision tasks.

- Standard computer vision tasks are designed to perform one-shot decision on images, with high generalization capabilities.
- Robot are designed to work in a fixed environments for a long time, seeing the same objects over and over again.

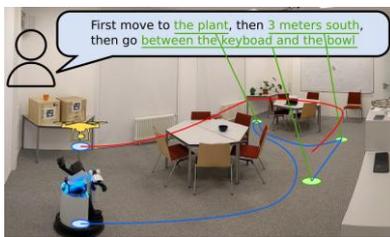


Example Application: Door Detection using a Mobile Robot

References: <https://arxiv.org/abs/2203.03959>



LLM and VLA navigation for assistive robots



Topic:
Starting from existing projects, integration of LLM and VLM for customization of the behaviour of socially assistive robots using behaviour trees



<https://segment-anything.com/>
<https://ok-robot.github.io/>
<https://vlmaps.github.io/>
<https://openai.com/research/clip>

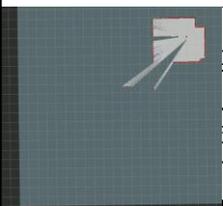
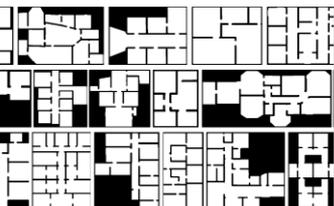
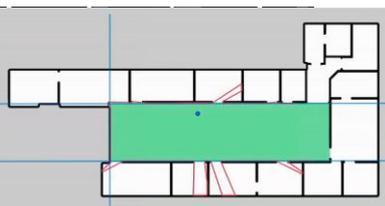
Competences: robot navigation, VLM and LLM prompting and fine tuning, ROS, PyTorch





Benchmarking robot exploration for indoor environments using docker and generative models



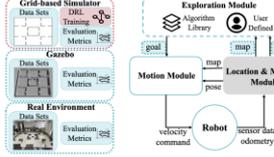




Topic:
Starting from existing projects, development of a benchmarking suite using ROS and docker to evaluate exploration strategies for autonomous mobile robot, also using generative models to increase the realism of the simulations.

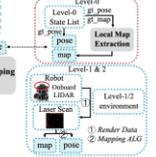
Development and testing of RL-based exploration strategies.



(a) 3-level platform



(b) Unified data flow and interface



(c) The perception part on different levels

Competences and technologies: autonomous mobile navigation, deep generative models, ROS, docker, PyTorch

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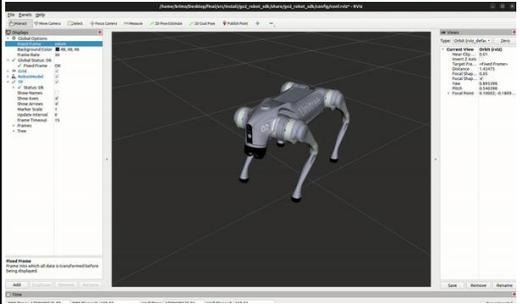
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Learned navigation in quadruped robots and Humanoids






Topic: Integration of the autonomous navigation stack of ROS with learned control policies for quadruped robots, in simulation or with real robots.

Possible extension to humanoid locomotion

Competences: robot control, simulation tools, ROS PyTorch, ISAAC

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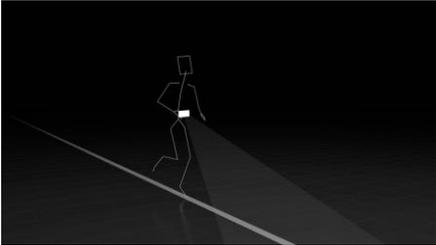
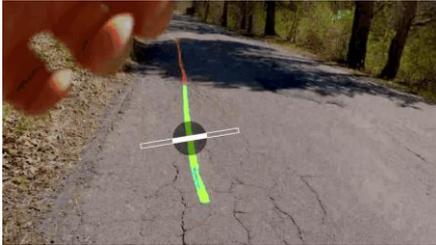
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Project Guideline



Project Guideline is a research project developed by Google that leverages on-device ML to enable people who are blind and low-vision to walk or run for exercise independently. The project aims to help people move freely and independently in the physical world.

Goal of this project is to replicate the opensource Google framework, detect its limitations and possibly improve it, to help a blind person to autonomously run on a real track (Giuriati).

<https://research.google/blog/project-guideline-enabling-those-with-low-vision-to-run-independently/>

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Multi-robot exploration



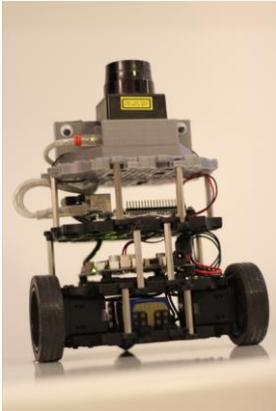
Development of a web-application for controlling with a dashboard a team of robots exploring an unknown environment.

Data perceived by the robots (localization on the map and camera stream) should be accessible from the dashboard

The user should be able to supervise the team of robots and send high-level directives for the team of robots

Skills: ROS, python, C++, mobile robotics

Real robots in the lab

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Human-robot interaction in augmented reality



We integrated has been integrated in a system of augmented reality:
Such system can do this

- See the robot's current state and map withing the real environment
- Interact with it by means of gestures
- Augmented perception with the robot sensors


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- **Goal of the project:** development of collaborative or competitive human-robot games based on this framework

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