

Laboratory: JRL-Japan, Tsukuba, Japon and LAAS-CNRS (Gepetto), Toulouse, France

Thematic: Robotics

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Titre : Hierarchical Quadratic Programming

Our team has developed a strong expertise on the generation of whole-body motion for real-size humanoid robot. In a controlled environment, we are able to walk, sit, carry objects, open doors and even dance. The motion generator is based on a generalization of quadratic programming, called hierarchical quadratic programming that is compiled in a dedicated efficient solver. This know-how gives us the best performances of our community.



Example of targeted dynamic whole-body movements

We now open a project to use theoretical properties based on the robot behavior model and on the solver layout to improve its behavior and performances. We want to deliberately degrade the algorithm (e.g. in terms of accuracy) while keeping a precise list of the resulting theoretical properties. In particular, to ensure a safe robot behavior, it is important to find a way to automatically regularize the problem when it is ill-conditioned (i.e. accept the return solution to be suboptimal if it is in exchange “safe” for a definition of safe to be mathematically defined).

The development of the numerical methods requires a good understanding of linear mathematics. Its validation will require a rigorous development phase, if possible pushing until the application into the physical robot HRP-2 to design and perform dynamic whole-body movements.

Requirements:

- Master degree in EE/CS or applied mathematics
- Experience in robotics or numerical computing
- Good programming skills in MATLAB/C/C++
- A strong mathematical background is desirable

Environment:

In the neighborhood of Tokyo, the JRL-Japan is a mixed French and Japanese team hosted by the AIST research center. The team benefits from the collaboration with one of the world-renowned team in humanoid robotics that has developed the humanoid robot family HRP. About 200 researchers work in robotics on the site, about 30 of them in the humanoid robot collaboration around 10 humanoid robot prototypes.

Located in the University town of Toulouse, in the south-west of France, the Gepetto group belongs to the CNRS-LAAS (Laboratory for the analysis and architecture of systems) laboratory, a 640 man strong research center with about 90 people working in robotics. Among our robot fleet, we have access to HRP-2, the only full-size walking humanoid robot in France. The laboratory benefits from strong connections to the adjoining universities and the space and aeronautics industry.