

# Making of a jumping robot

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Toward is a new french startup focused on R&D for Humanoid robots with a research partnership with Pal Robotics. PAL Robotics is a leading company dedicated to service robotics, with the mission of enhancing people's quality of life through Service Robotics. This is done by providing robotics products and services that range from robots specific for industry, to research platforms. The latter include our well-known biped humanoid robots, REEM-C and TALOS. These platforms allow to test the latest advances in locomotion related research. At PAL Robotics, we are currently doing a step further in the design of a robust biped research platform, to be able to provide a humanoid robot that is capable of performing highly dynamic motions. In this talk, the new PAL Robotics' humanoid Kangaroo will be presented.

Dynamic capabilities require the platform to be lightweight and with low inertia, but able to provide high torque and speed. Robustness of the hardware is also required to be resilient to impacts. This led to a complete change in the paradigm of the previous biped robots at PAL Robotics. Namely, the key aspects that had to be rethought to that end were:

- 1) *Mechanical design*: Reduction of the inertia and mass of the legs. This has been achieved by moving the actuation up towards the torso using bar linkages to actuate the joints.
- 2) *Actuation*: Requirement of high backdrivability at actuator level. This has led to opt for linear actuators (ball screws) instead of rotary actuators. Linear to rotary motion leads to nonlinearities that have to be handled at the transmission level.
- 3) *Software design*: Development of custom transmissions in ROS control that exhibits transparency at control level.
- 4) *Electronics design*: To achieve high bandwidth

torque control new custom electronics have been designed at PAL Robotics.

In this talk the advances and preliminary results of the development of this new platform will be presented. More concretely, the concepts on which the Kangaroo robot is based will be presented, including a comparison with other robotic platforms. The challenges that result from these developments, from the hardware and the software perspectives, will be described and discussed. Preliminary experiments to demonstrate the capabilities of the robot have been implemented, tested and recorded, and will also be shown.

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