robotics Swiss National Centre of Competence in Research

NEWS BULLETIN

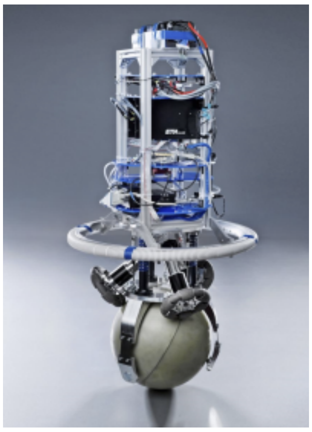
Issue 16

Robot motion planning

When you go to make your movement across a room or down a path your brain makes thousands of tiny decisions on how best to move, such as how to use your weight, what obstacles or uneven surfaces there may be and how rigid or soft your limbs and joints should be. How to teach a robot how the same decision making process is an ongoing question in robotics but a team from ADRL, ETH Zurich and NCCR Robotics explores numerical methods for trajectory optimisation

VIDEO

Using a method of control called direct transcription (where complex mathematical problems are broken down into smaller problems and each solved individually), the team use direct transcription to enable an unstable ball-balancing robot to perform a series of tasks with increasing complexity. The common issue with direct optimisation methods, which are used to allow the robots to obtain more natural movements, is that they require computers to continuously run multiple algorithms at once, meaning that planning a path in real time, like the human brain does, has not yet been achieved. Simply put, the computers working online with a robot are nowhere near as fast, efficient and robust as your brain, and that's before considering how heavy such a computer might need to be, or how much bandwidth this communication requires.



After first using computer models, the team tested the unstable ball balancing robot (see the video) with three variations of a simple task where the robot had to move from one location to another while avoiding fixed obstacles. By allowing the robot to use the best solution that it found for previous tasks, coupled with a feedback controller to stabilise the system, the simulated robot was able to find a path through two obstacles in under a second. When using the real robot, the same paths and trajectories were followed, with the robot reaching the planned destination safely and in the same period of time as the virtual robot, thus validating the hypothesis.

The speed with which the robot is able to assess its scenario and follow a path that it has decided for its self without falling is a positive step forward which can be transported onto more complex robots (such as quadrupedal robots) in more uneven environments. If a quadrupedal robot, such as HyQ or StarlETH is able to understand obstacles in its path and successfully avoid them or modify a movement to accommodate them, such as softening joints when walking over rocks, then robots have just made one step further towards regularly being sent to disaster zones to locate victims and save more lives.

References

D. Pardo, L. Möller, M. Neunert, A. W. Winkler and J. Buchli, "Evaluating direct transcription and nonlinear optimization methods for robot motion planning", IEEE RA-L, 2016.

For Further Information please refer to:

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NCCR Robotics

The Swiss National Center of Competence in Robotics (NCCR Robotics) is a federally funded programme bringing together

robotics laboratories from EPFL, ETH Zurich, University of Zurich and IDSIA to work on wearable, rescue and educational robots.

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