Numerical methods in motion planning for legged robots

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Legged robots have an inherent potential to traverse rocky and steep terrain that wheeled robots cannot. Thus they show promise for applications like interplanetary exploration, search and rescue, or offroad transportation. I will present a general-purpose quasi-static motion planner for legged robots based on probabilistic roadmaps (PRMs), a motion planning technique used for high-dimensional configuration spaces. It uses numerical computation extensively. The PRM method tests thousands of robot configurations for equilibrium and torque limits using linear programming, polytope projection, and linear complementarity problems. Nonlinear optimization is used to sample configurations that satisfy closed-chain and equilibrium constraints. Optimal control techniques are used to convert quasi-static paths to dynamically feasible trajectories. I will discuss the major issues in the application and implementation of numerical algorithms in this planner, and suggest areas for future improvements.