Time-optimal trajectory planning under dynamics constraints: Old algorithm, new applications

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Finding the time-optimal trajectory between two robot configurations under dynamics constraints (such as torque limits) is very difficult and time-consuming even for 3-DoF robots. However, if a path is given, then the time-parameterization of that path that minimizes the traversal time can be computed exactly and very efficiently, thanks to an algorithm discovered and developed in the 80's and early 90's by prominent researchers such as J. Bobrow, S. Dubowsky, K. Shin, N. McKay, J.-J. Slotine, or Z. Shiller, to name a few. Since then, however, this powerful algorithm has not received the widespread attention it might deserve, probably because of the many complications it involves and the consequent lack of an open-source, versatile, robust implementation. Here we introduce a preliminary version of such an implementation, as a component of the OpenRAVE robotic simulation platform. We then present several applications, including trajectory smoothing using time-optimal shortcuts and trajectory deformation for pick-and-place tasks on conveyor belts.