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Improved Methods for Modeling Multi-Contact Robotic Interactions

Researchers at the Stanford Robotics Lab have developed new methods for modeling multi-contact collisions and steady physical interactions between multiple rigid bodies. This work is needed because simulation of robotic manipulators in contact-driven tasks require stable and smooth estimates of contact forces. Current polygon-mesh methods lead to jitter and computational inefficiency in determining contact forces and the resulting motion of objects. **The new, geometric-composition approach addresses these limitations to generate smooth contact forces in computer simulations**. Using a common contact frame rather than multiple points, and using primitive shapes (e.g., cones, spheres) as approximations for complex organic shapes, the approach reduces computational time and complexity. It also produces smooth motions of objects that are closer to physically observable motion. This technology can be used for commercial simulation or analysis software applicable to multi-body simulation, computer games, and robotics to design robots or develop control algorithms for robotic manipulation.

Stage of Development
Proof of concept

Applications

- Commercial simulation and analysis software for multi-body simulation, computer games and robotics

Advantages

- Faster, less expensive computation

- Reduces instability (jitter) of contact point
- Produces physically consistent and numerically stable results for contact forces between bodies
- Results can be channeled through virtual force sensors for compliant manipulation control strategies

Publications

- Ganguly, Shameek, and Oussama Khatib. "Contact-space resolution model for a physically consistent view of simultaneous collisions in articulated-body systems: theory and experimental results." *The International Journal of Robotics Research* 39.10-11 (2020): 1239-1258.

Patents

- Published Application: WO2022076410
- Published Application: 20230259663

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