

Geometric Planner for In-Hand Manipulation with Multi-fingered Hands

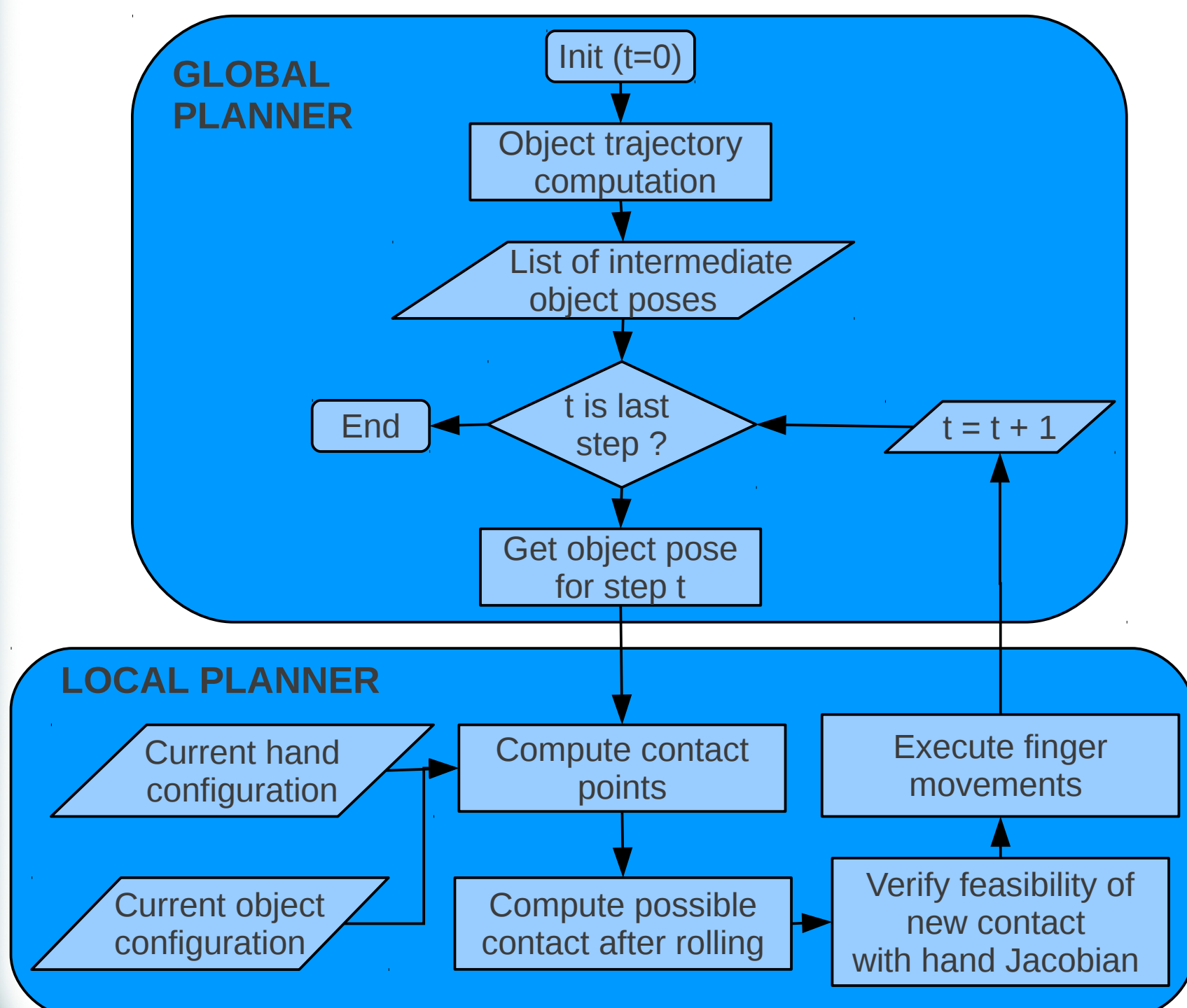
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Motivation

- **Dexterous Manipulation problem** with multifingered hands:
 - Input: Initial grasp and desired object configuration
 - Output: Evolution of finger joints to move the object
- Previous approaches require a parameterizable surface of objects and fingers or **simple shapes** (spheres, ellipsoids, etc.).
- A new approach is proposed where object and finger surfaces are represented as generic **triangle meshes**.

Dexterous Manipulation Algorithm

- The proposed **geometric planner** solves the dexterous manipulation algorithm by computing the contact evolution between the triangle meshes of the surfaces of the object and the fingers. It is divided into:
 - The **Global Planner** computes the trajectory of the object without considering the hand.
 - The **Local Planner** computes the finger joint variations which are required to move the object between two consecutive configurations of the object trajectory given by the global planner.

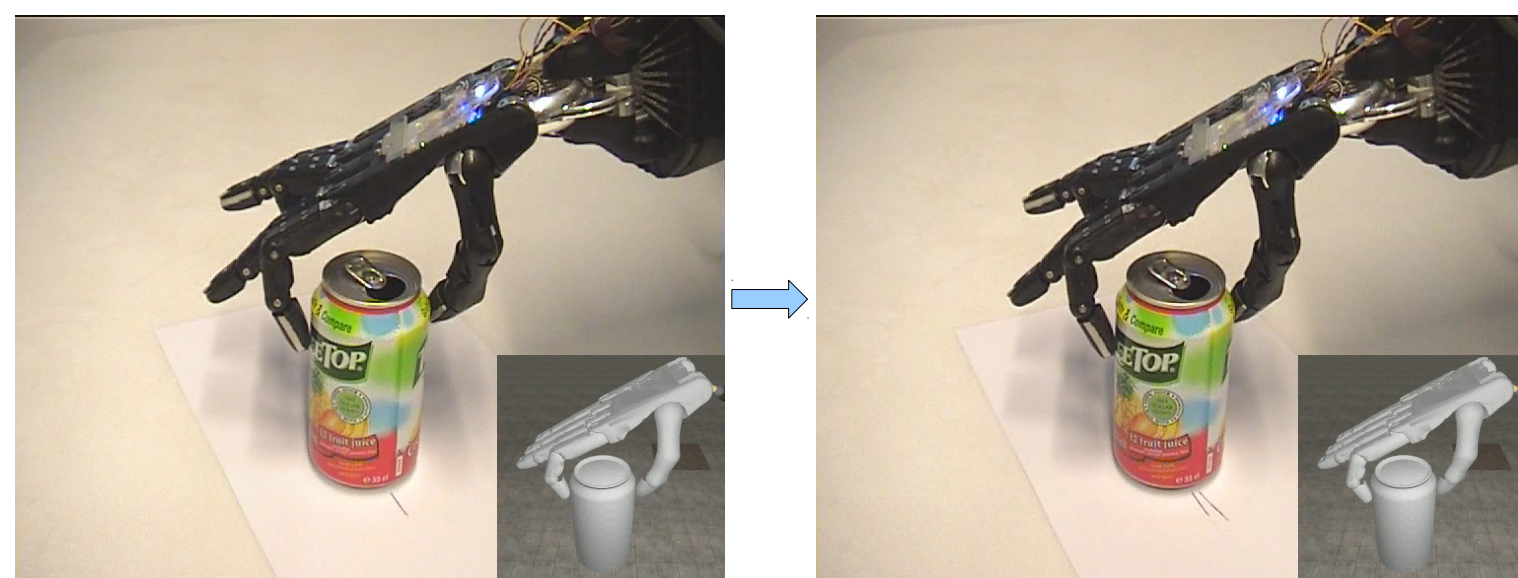


Marilou Implementation

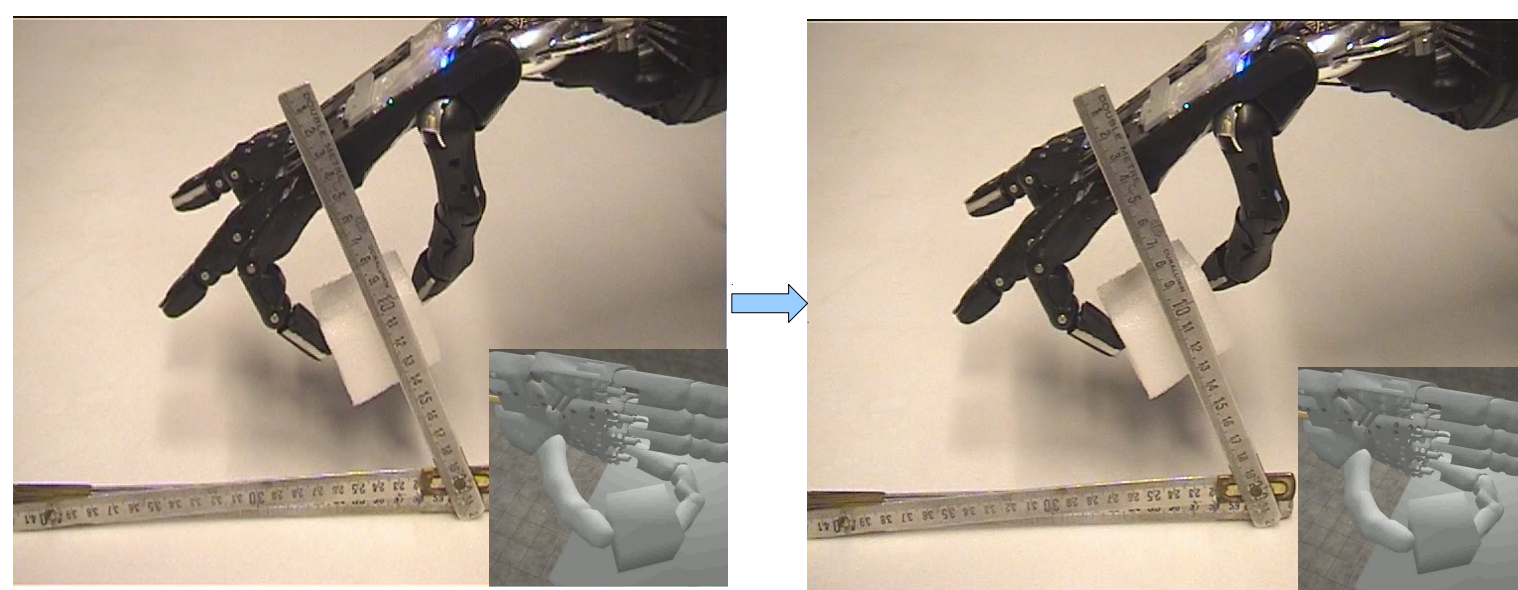
- C++ program which communicates with the **Marilou Robotics Simulator**. The simulator performs rigid body dynamic simulation and contact point computation.

- The movements have to be played off-line in the real hand.

10° Rotation of a soda can

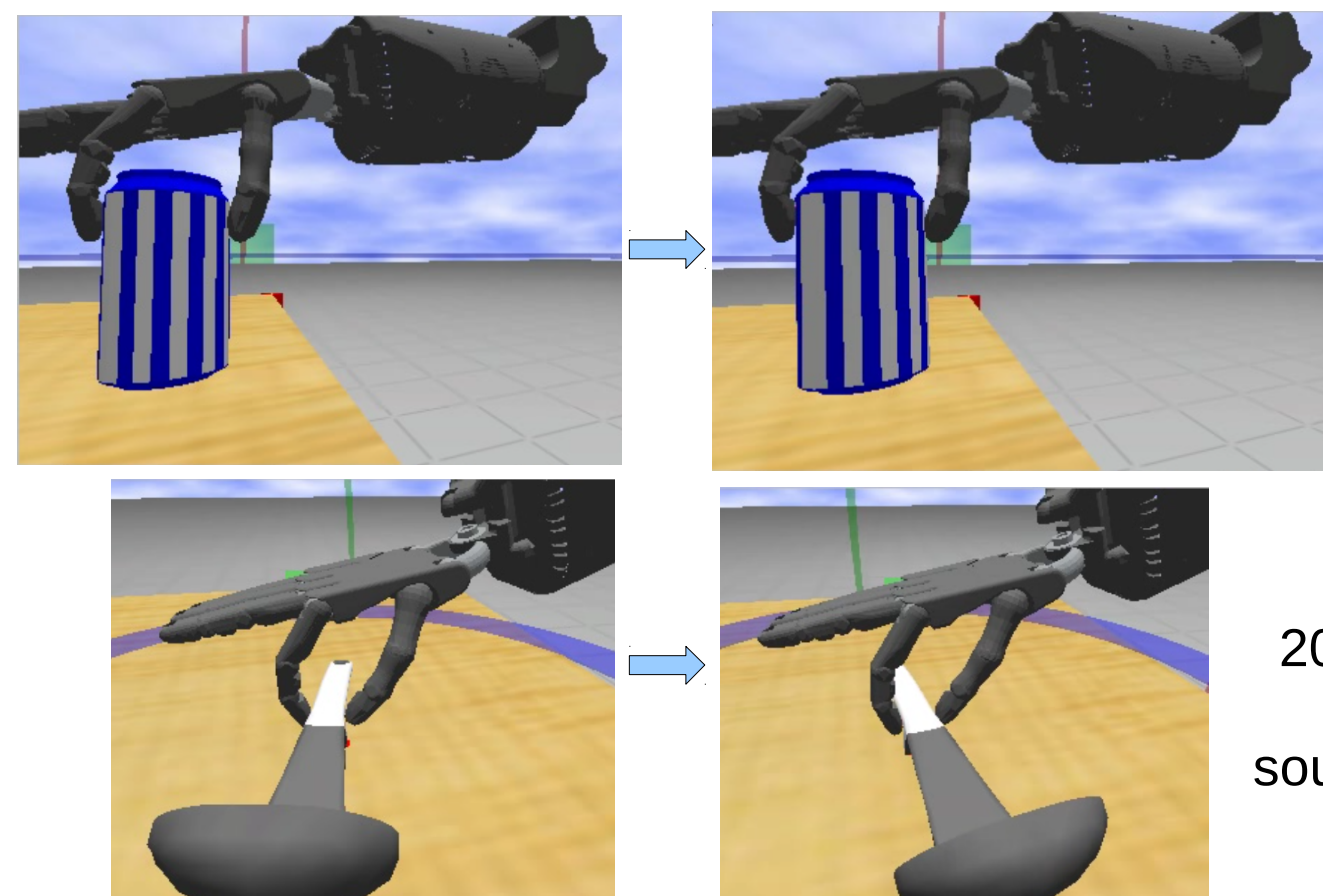


1cm Translation of a cube



ROS Implementation

- C++ program which communicates with **ROS and Gazebo**. Contacts are obtained from Gazebo bumpers.



10° Rot. of a soda can

20° Rot. of a soup ladle

Acknowledgments

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Conclusions

- A new dexterous manipulation algorithm based on triangle mesh surface representation is designed and implemented in Marilou and ROS (Gazebo).
- **Future work:** When long movements of the object are performed, the contact might be lost because of too small contact forces. The algorithm should try to guarantee the application of a minimum contact force to avoid weak contacts.

