Representations for Manipulation of Articulated Objects

Terminology and Notation

The deformable model (d-model) is a graph $G = (V, E)$ with vertices $v \in SE(3)$ and the edges representing the kinematic constraint between the vertices. A vertex v is defined by the position of the point x and its rotation R with respect to the world frame. For vertices $v_i, v_j \in V$, the correspoding edge $e_{ij} = (v_i, v_j)$ is associated with three parameters $(\tau_{ij}, c_{ij}, r_{ij})$ defined by:

$$
\tau_{ij} = \begin{cases}
0 \text{ if the joint is rigid} \\
1 \text{ if the joint is prismatic} \\
2 \text{ if the joint is revolute} \\
3 \text{ if the joint is planar (no rotation)} \\
4 \text{ if the joint is cylindrical} \\
5 \text{ if the joint is planar} \\
6 \text{ if the joint is spherical} \\
7 \text{ if the joint is a helix}
\end{cases}
$$

Rigid joint

c_{ij} and r_{ij} are undefined.

Prismatic joint

c_{ij} is the direction of motion defined by the prismatic joint. r_{ij} is undefined.

Revolute joint

c_{ij} is the axis of rotation and r_{ij} is the radius of rotation.

Planar joint (no rotation)

c_{ij} is the normal to the plane of motion.

Spherical joint