Constraint-Based Generation of Trajectories for single-Arm Robots

Mathieu Collet¹²³, Arnaud Gotlieb², Morten Mossige¹³

¹ University of Stavanger, 4036 Stavanger, Norway
² Simula Research Laboratory, Lysaker, Norway
³ ABB Robotics, 4349 Bryne, Norway

Introduction
- The software testing is an important activity during software development
- Large diversity of robot configurations
- By the using of intelligent processes (constraint programming over continuous domains), test cases will be automatically generated
- Include diversity between tests

CCB and RT Generation component
- Based on a RealPaver, a constraint solver over continuous domain
- Check the reachability between two points by checking the non-existence of intersection between the line passing by the two points and the various forbidden areas
- Build the graph of connection and the accessibility matrix between all points.

Continuous Constraint Solver
- Available though modeling languages for numerical constraints
- Solving non-linear constraints by interval computations which is useful since robot motions can be non-linear
- The variables takes their values in the continuous domain
- Reduce the initial domain to give a set of solutions

Robot space configuration modelling
- The modelling of the space configuration is based on basic shapes (square, triangle, circle)
- The solver is based on Realpaver, and use to determine if a trajectory is crossing a forbidden zone

Trajectory definition
- N points are randomly inside the working zone
- A trajectory begin from a starting point, pass through N points and finish by an ending point
- Trajectory have a cost given by:
  \[ C_T = \sum_{i=0}^{N} C_{\text{seg}} \]

Perspectives
- Multi-robot modelling
- Integration of collision zone
- Manage singularity points
- Use 6D dimensions