TOPOLOGICAL COMPLEXITY AND EFFICIENCY OF MOTION PLANNING ALGORITHMS

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A motion planner in a space X is an algorithm which, given a pair of points $(x, y) \in X \times X$, outputs a path in X with initial point x and terminal point y. This notion is usually considered in the context of robotics, where X is taken to be the space of all states ("configuration space") of a mechanical system. One would hope for a motion planner that is stable in the sense that a minor change of either the initial or terminal state results in a predictable change of the path taken by the mechanical system. This, however, turns out to be rarely possible. In order to quantify the "order of instability" of configuration spaces of mechanical systems, Farber [2] introduced the notion of topological complexity.

A shortcoming of Farber's approach is that it does not take into consideration any notion of efficiency of motion planners, e.g. measured in terms of covered distance or spent energy. Yet motion planners which do not comply with basic constraints (e.g. a path from any state to itself is constant) should be ruled out as inadequate. Also, one would like to be able to quantify efficiency of motion planners in order to compare them.

I will discuss a variant of Farber's topological complexity, defined for smooth compact Riemannian manifolds, which addresses the problem hinted at above by taking into account only motion planners with the lowest possible "average length" of the output paths.

The talk is based on joint work with J. G. Carrasquel Vera.

REFERENCES

[1] Z. Błaszczyk, J. G. Carrasquel Vera: *Topological complexity and efficiency of motion planning algorithms*, to appear in Rev. Mat. Iberoamericana, arXiv:1607.00703.
[2] M. Farber: *Topological complexity of motion planning*, Discrete Comput. Geom., **29**, No. 2 (2003), 211–221.

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