On the Number of Critical Free Contacts of a Convex Polygonal Object Moving in Two-Dimensional Polygonal Space

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Given a convex polygonal robot B with k edges capable of translation and rotation, and a set of polygonal obstacles $\{A_1, \ldots, A_m\}$ each with n_i sides and $n = \sum_{i=1}^{m} n_i$, Leven and Sharir [1] prove that the number of critical placements of B at which it makes 3 simultaneous contacts with the obstacles but does not intersect their interior is $O(kn\lambda_6(kn))$, where $\lambda_s(u)$ is the maximum length of a Davenport-Schinzel sequence of u symbols of order s.

The main idea of their proof technique is to transform this 3-dimensional (since both translation and rotation are allowed) problem into a set of 2-dimensional problems involving the complexity of lower envelopes of certain functions. They then use the results on the complexity of lower envelopes to establish this bound. In this talk I will mainly focus on this transformation and the associated case analysis for the proof of the above bound.

References

[1] Daniel Leven and Micha Sharir. On the number of critical free contacts of a convex polygonal object moving in two-dimensional polygonal space. *Discrete & Computational Geometry*, 2:255–270, 1987.