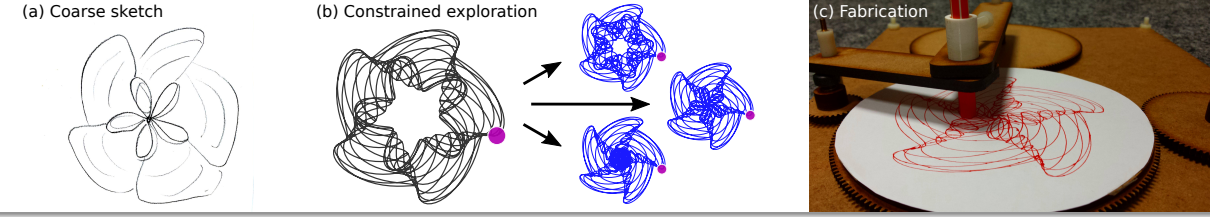

SPIROU: Constrained Exploration for Mechanical Motion Design

Symposium on Computational Fabrication

Robin Roussel [1,2] Marie-Paule Cani [2] Jean-Claude Léon [2] Niloy J. Mitra [1]

[1]University College London [2]Grenoble-Alpes University and Inria

June 13, 2017

Drawing machines

Drawing machines

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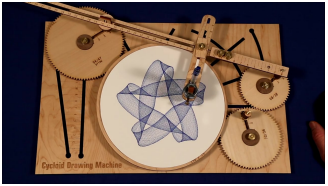
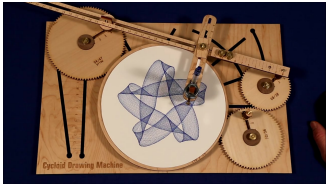
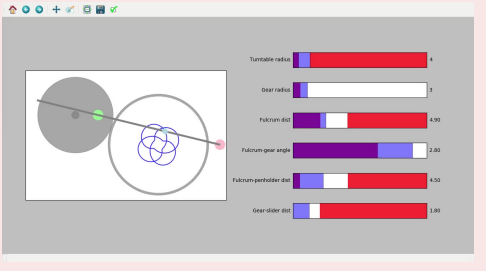


Drawing machines



Problem



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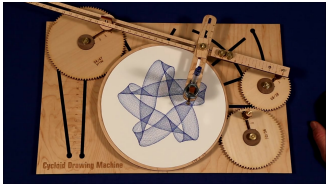

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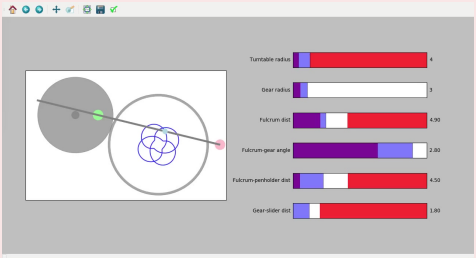
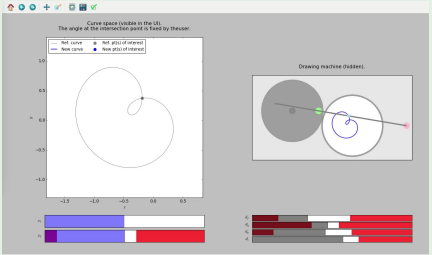


Objective



Related work and contributions

		What is designed	
		Shape	Motion
Design process	Query and optimization		
	Constrained exploration		

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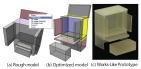
Design process	Query and optimization	 [Koo et al. 2014]	[Coros et al. 2013] [Bächer et al. 2015]
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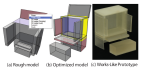
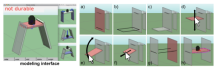
Design process	Query and optimization	 [Koo et al. 2014]	[Coros et al. 2013] [Bächer et al. 2015]
	Constrained exploration	 [Umetani et al. 2012] [Shugrina et al. 2015]	

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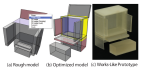
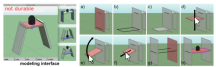
Design process	Query and optimization	 [Koo et al. 2014]	[Coros et al. 2013] [Bächer et al. 2015]
	Constrained exploration	 [Umetani et al. 2012] [Shugrina et al. 2015]	Our method

Outline

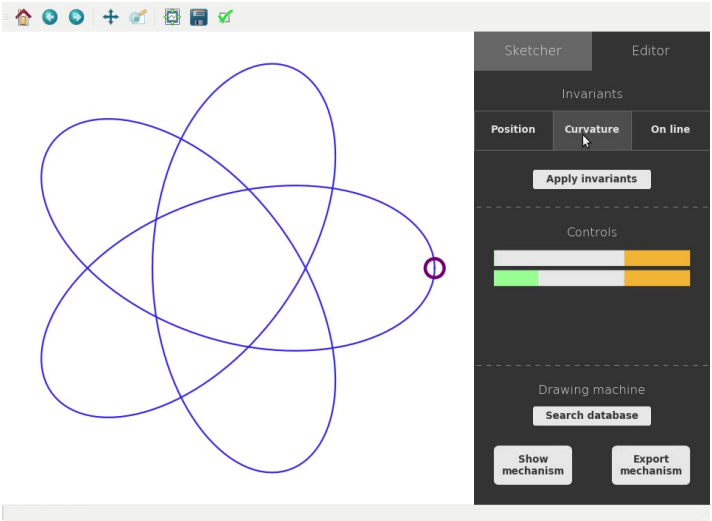
Introduction

Method

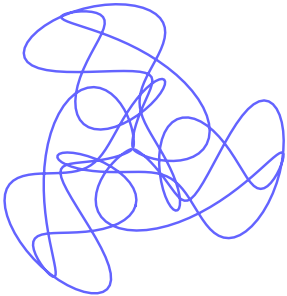
Results

Conclusion

Workflow


Sketcher
Editor
Invariants
Position
Curvature
On line
Apply invariants
Controls
Drawing machine
Search database
Show mechanism
Export mechanism

Points of interest and invariants



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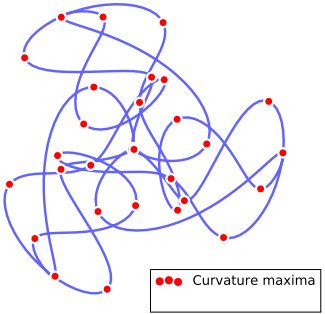

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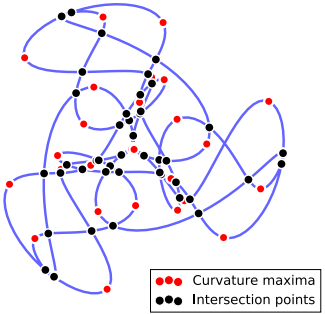

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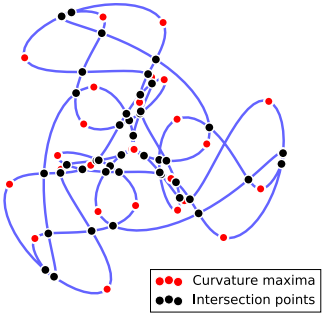

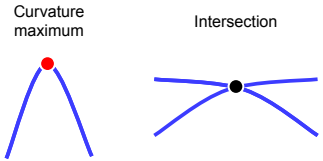

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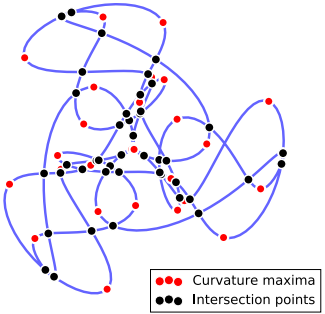

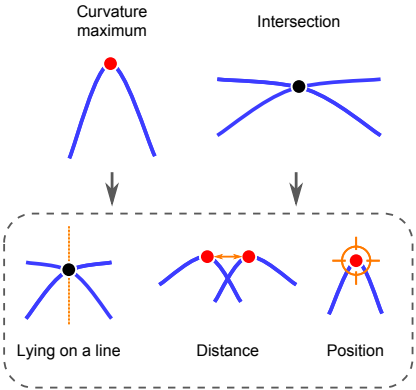

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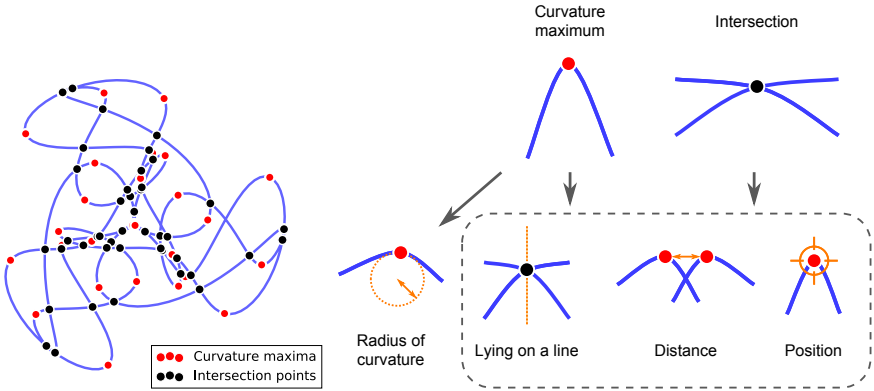

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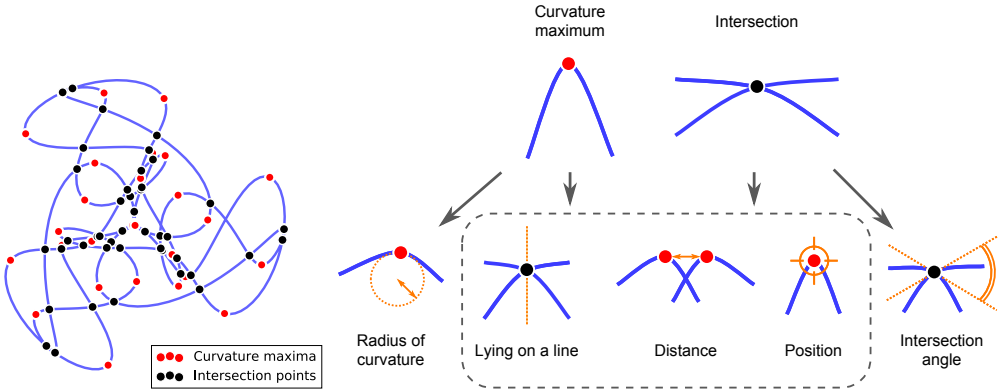
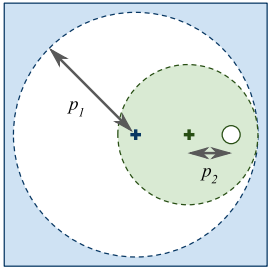


Implementation

Internal representation

Parametric model



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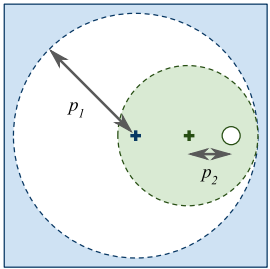
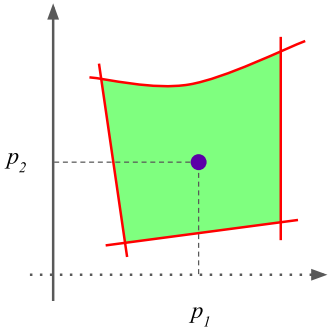


Design space



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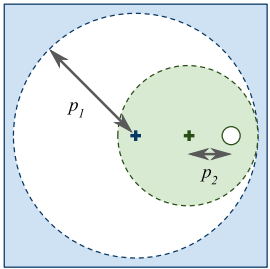

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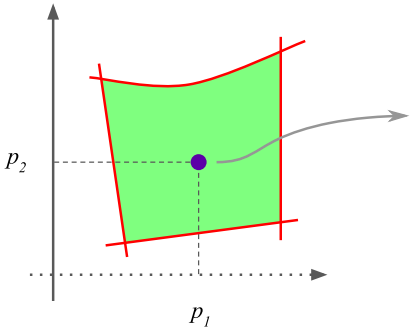
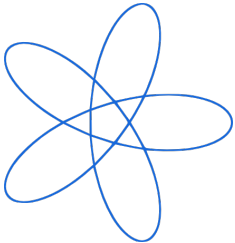
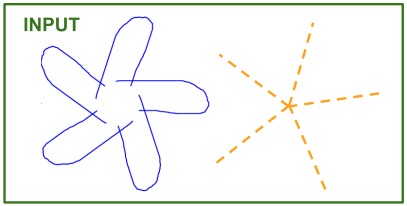


Simulator



Implementation

Sketch-based retrieval



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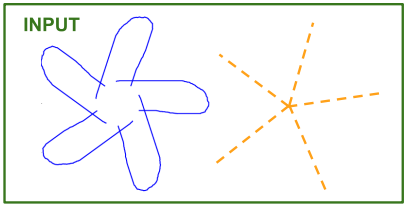
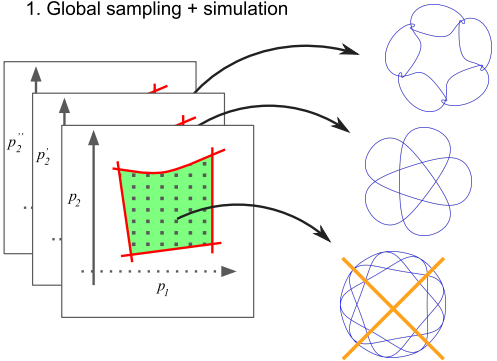


1. Global sampling + simulation



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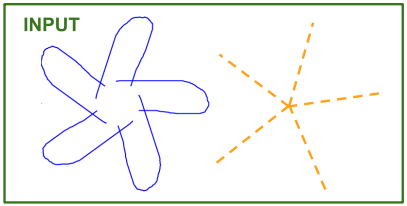

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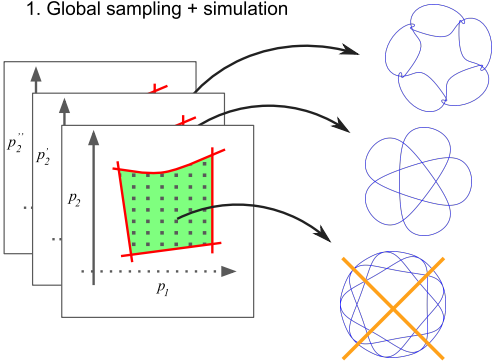
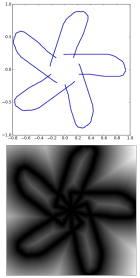
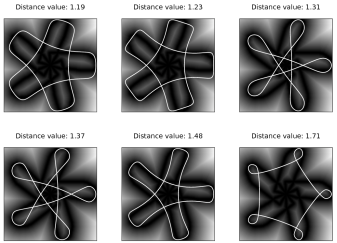


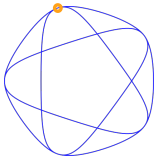
2. Normalization + Dissimilarity evaluation





Implementation

Invariance score



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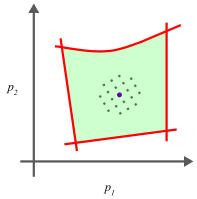

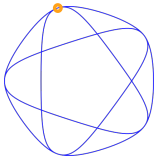

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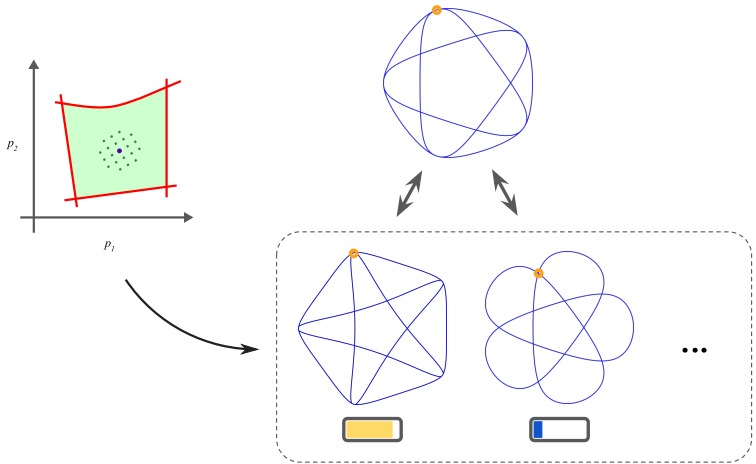

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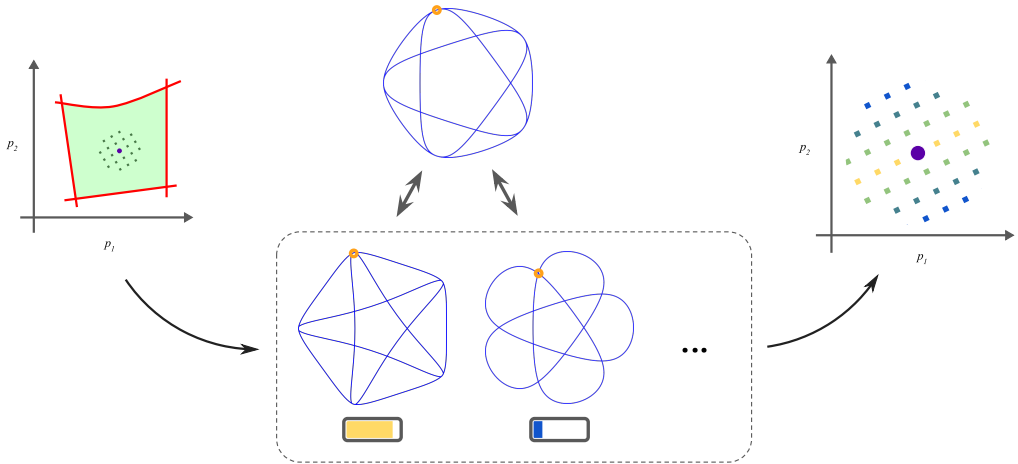
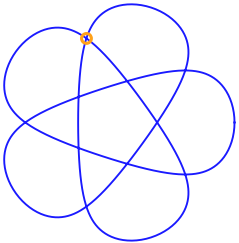


Implementation

Assigning an invariance score

The tracking problem



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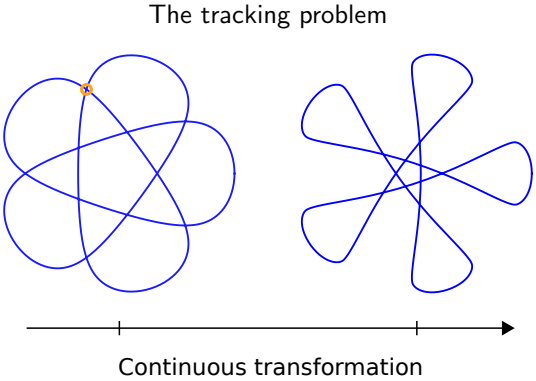

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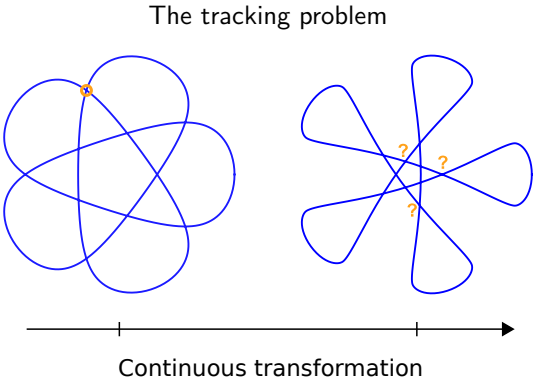
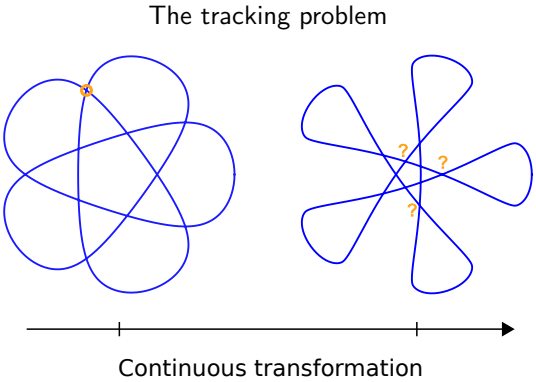
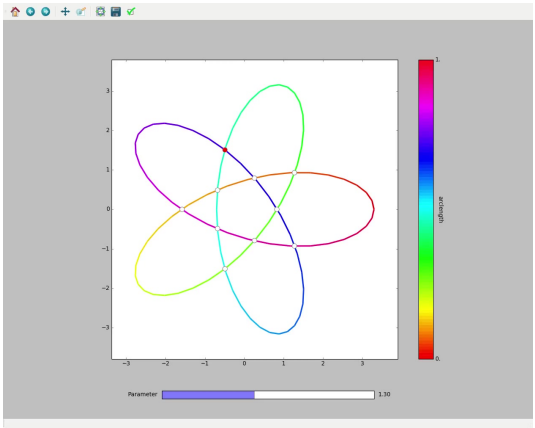
Assigning an invariance score



Implementation

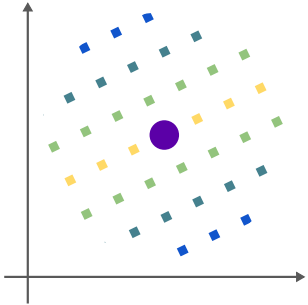
Assigning an invariance score

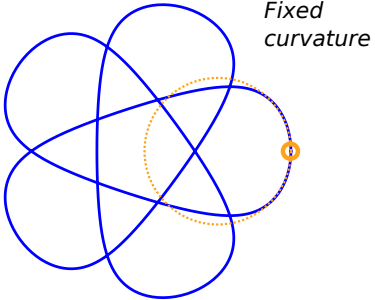




Implementation

Approximating the invariant space





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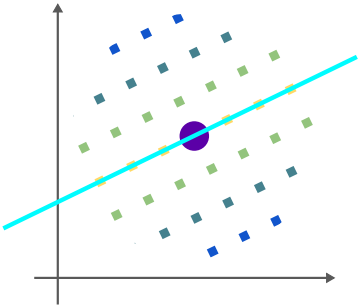
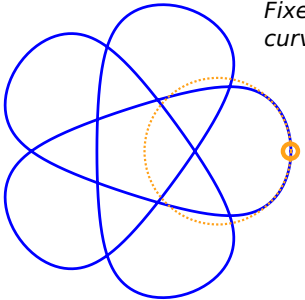


Weighted Principal Component Analysis



Implementation

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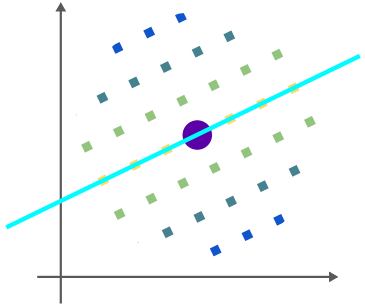

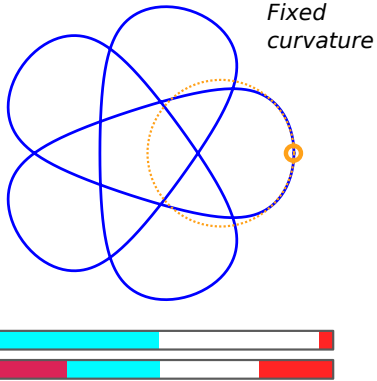

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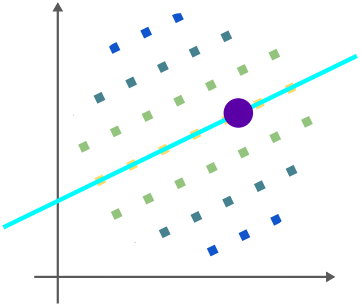
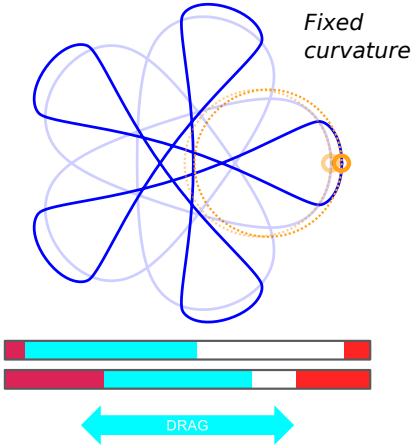
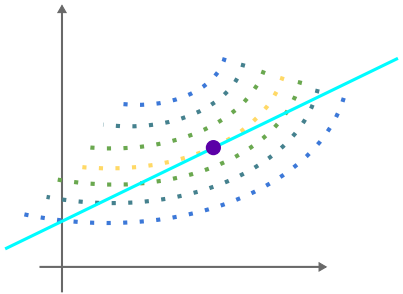
Approximating the invariant space



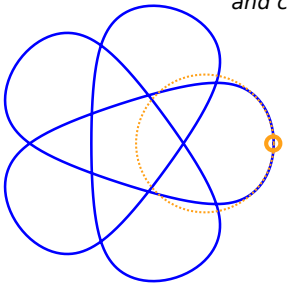


Implementation

Updating the approximation



Fixed position and curvature



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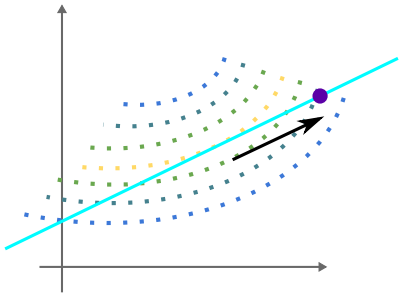

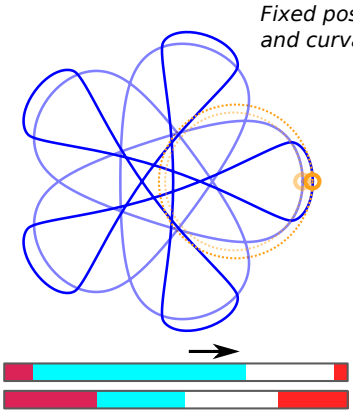

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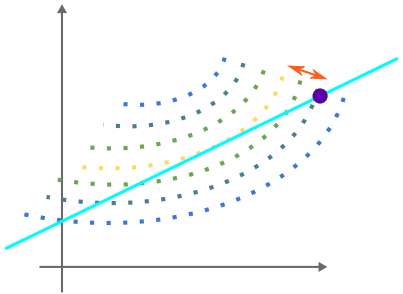

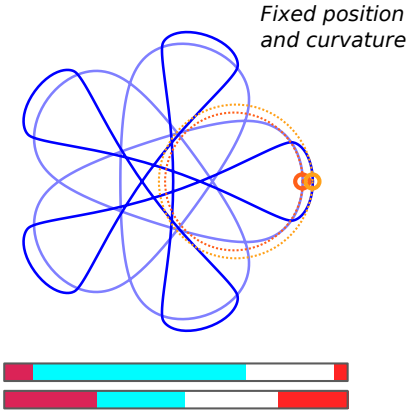

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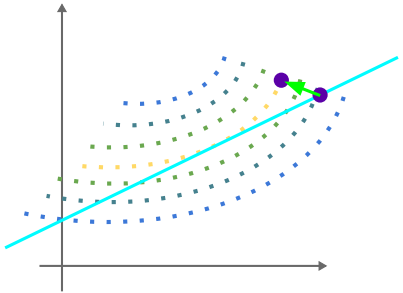

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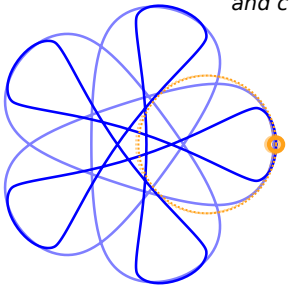

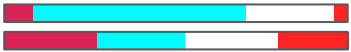

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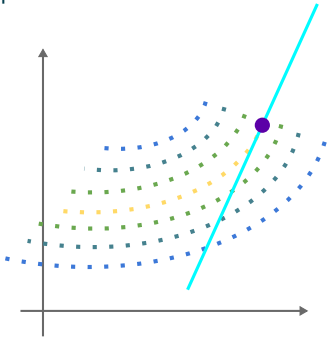

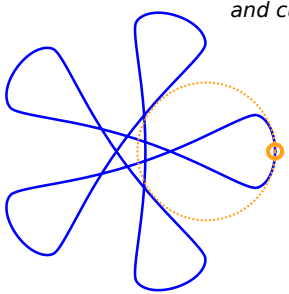

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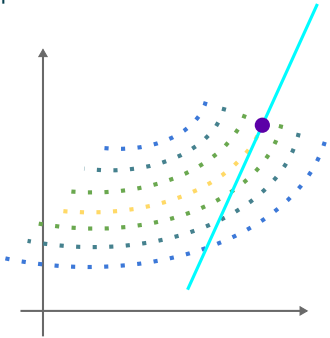

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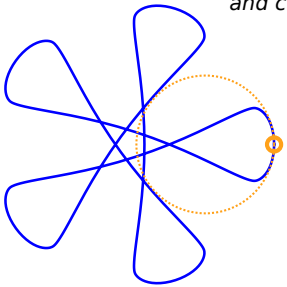

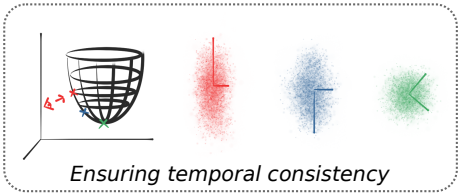

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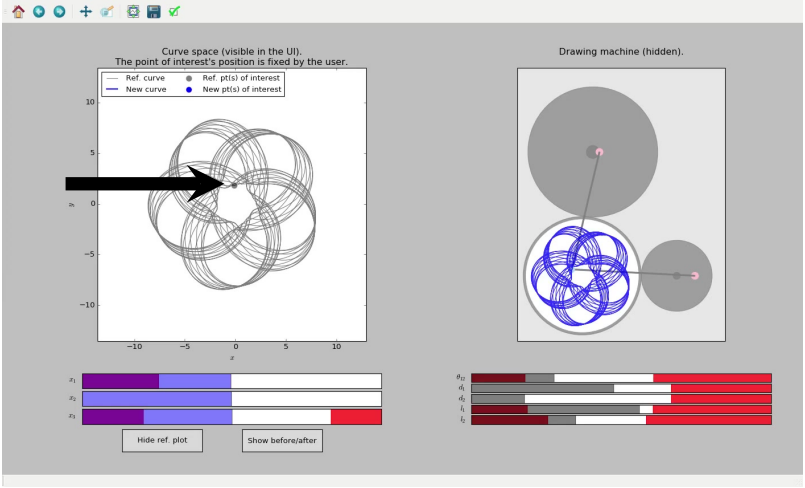
Validation

Demo: fixed point position



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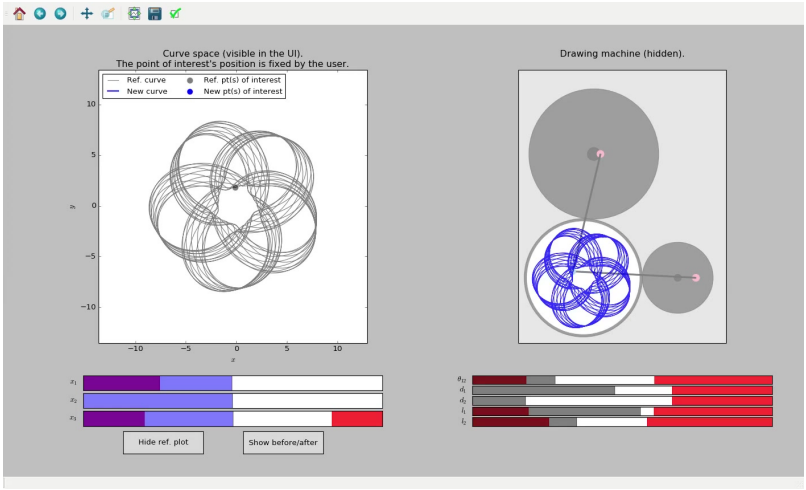

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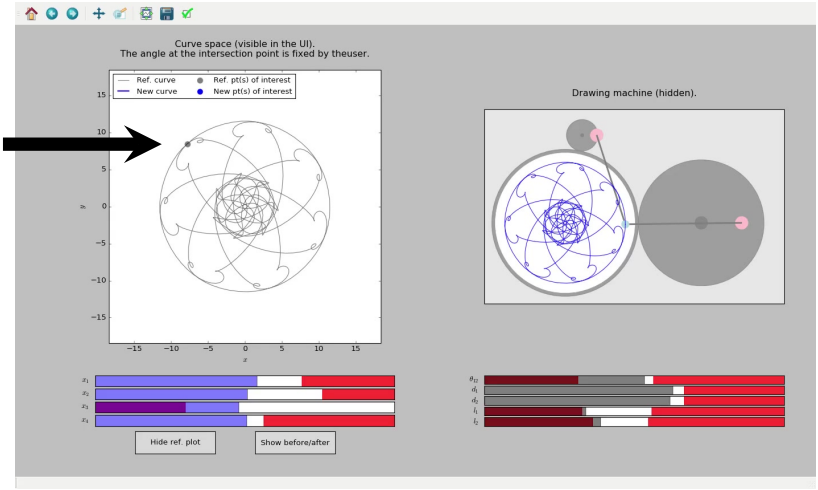
Demo: fixed curve tangency



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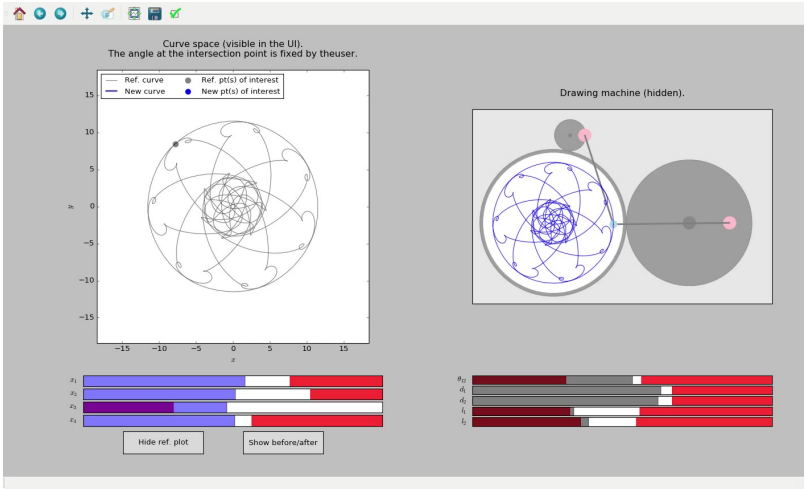

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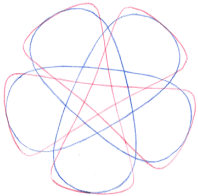
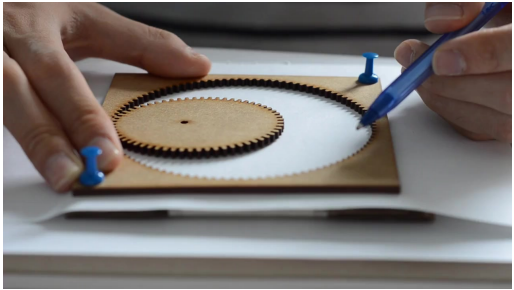
Fabrication

Elliptic Spirograph





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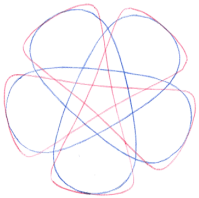
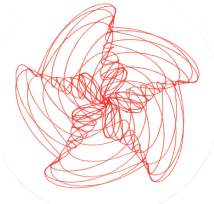
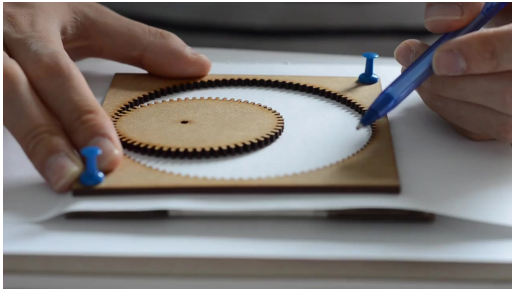
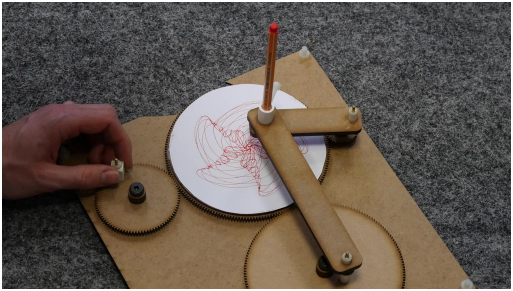


Hoot-Nanny







Limitations and future work

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- Explore different sampling/regression strategies to avoid combinatorial complexity
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Secondary:

- Perceptual study (visual clues, curve metric)
- Take physical effects into account (friction, gear play)

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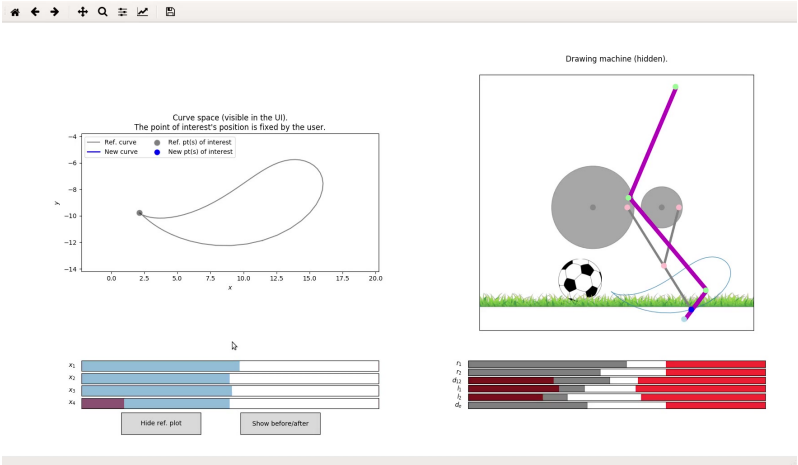

Project page [with code next week]:
`http://geometry.cs.ucl.ac.uk/projects/2017/constrained-exploration/`