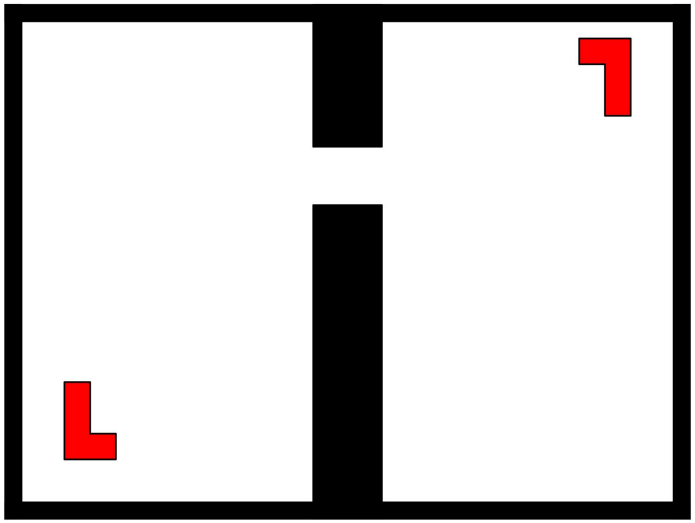
Dynamic Region-biased Rapidly-exploring Random Trees

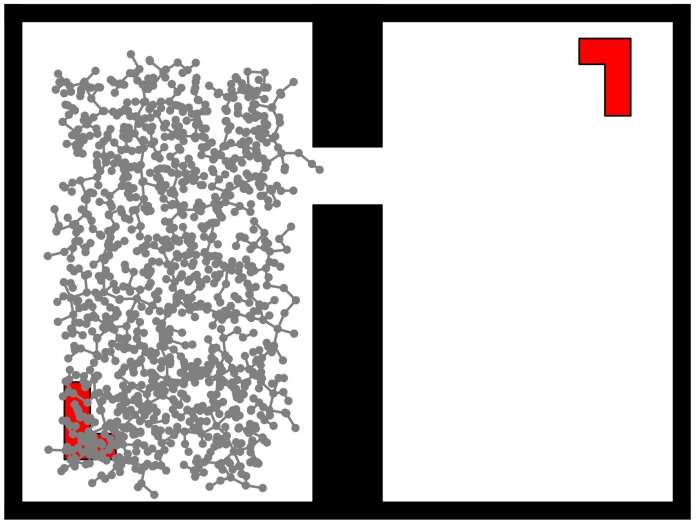
Project by Ryan Gibson

Based on a paper by Jory Denny, Read Sandstrom, Andrew Bregger, and Nancy M. Amato

Problems with RRT

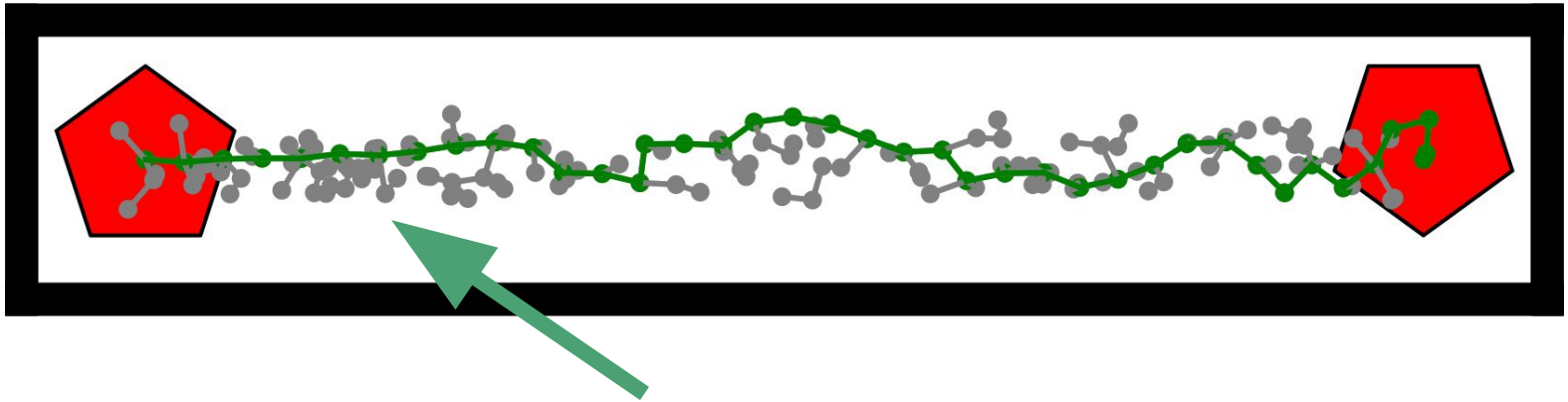
- Poor performance in environments with “narrow passages”





Problems with RRT

- Random growth leads to suboptimal performance in most environments



Idea: Grow Tree Along Workspace Paths

- Valid paths necessarily follow paths through the free workspace, so use them
- Can efficiently represent the free workspace via a “Reeb graph”

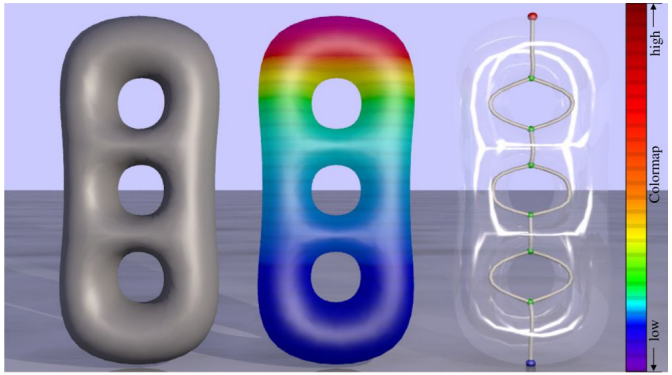
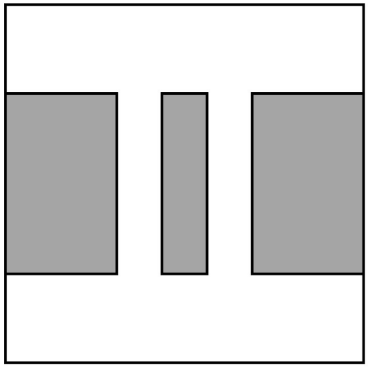
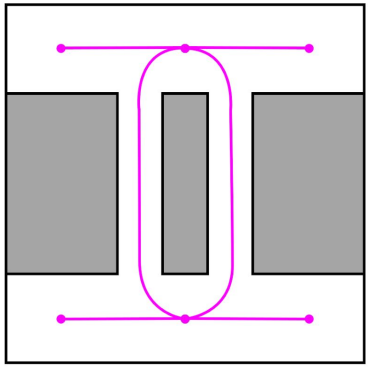


Figure 2: Reeb graph of the height function on the triple torus. The three tunnels of the model are mapped to three loops in the graph.

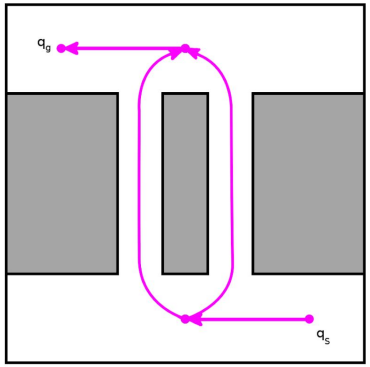
Basic DRRRT pipeline



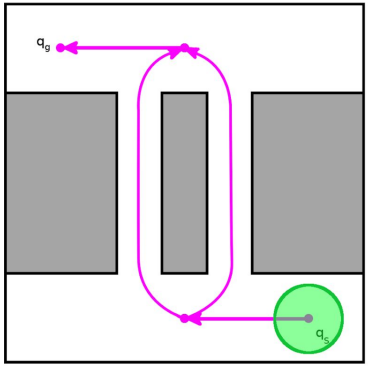
(a) Environment



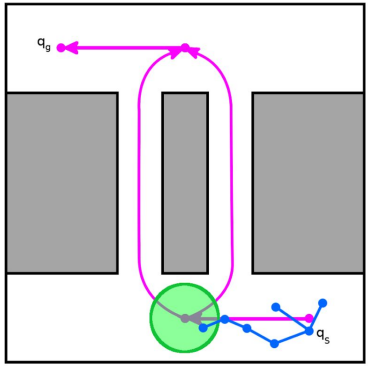
(b) Embedded Graph



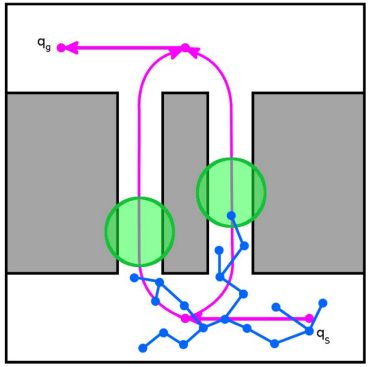
(c) Flow Graph



(d) Initial Regions



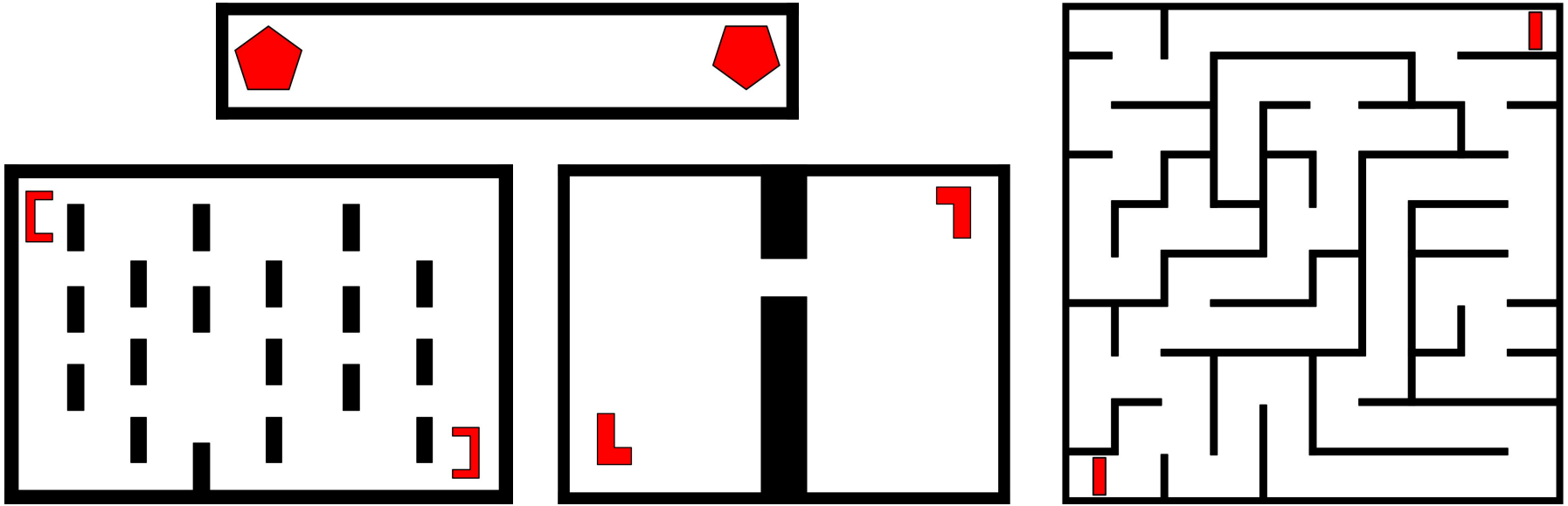
(e) Tree Growth



(f) Multiple Regions

Results

- We evaluate RRT/DRRRT in four environments
  - “Hallway”, “Barriers”, “Narrow”, “Maze”



Results

Planner	RRT			DRRRT		
	Success Rate	Nodes	`Clear` calls	Success Rate	Nodes	`Clear` calls
Hallway	100%	62	532	100%	47	231
Barriers	83%	660	16.9K	100%	326	12.5K
Narrow	45%	1150	11.5K	82%	72	5.2K
Maze	0%	*	*	100%	171	1288

Table 1: Success rates, average number of tree nodes, and average number of `Clear` calls for RRT and DRRRT motion planning in our four environments. Results are averaged over 1000 trials, only including runs that found a valid path before calling `Clear` 25K times.

Results -- Left: RRT, Right: DRRRT