

Online Motion Planning, SS 17
Exercise sheet 6
University of Bonn, Inst. for Computer Science, Dpt. I

- *You can hand in your written solutions until Tuesday, 30.05., 14:15, postbox in front of room E.01 LBH.*

Exercise 16: Comparison of Bug-variants (4 points)

- Present an example where strategy Bug1 beats the strategy Bug2 w.r.t. path length.
- Show the tightness of the three presented Bug variants Bug1, Bug2 and ChangeI, i.e., show by examples that you can get arbitrarily close to the presented path length.

Exercise 17: Variant of 2-ray search (4 points)

We consider the following variant of the 2-ray search for a target point. The corresponding unknown target point t is located on two rays which build a right angle at the common source s as shown in Figure 1.

The agent starts at s and detects the unknown target t only by touching it. For moving back from one ray to the other the agent can move in the *free space*. Figure 1 shows such a short-cut. Note that a reasonable strategy has to visit the point on both rays consecutively by increasing distance.

- Describe a reasonable strategy and its local worst-case situation by functionals in analogy to the standard 2-ray case.
- Find the optimal strategy by application of the Theorem of Gal. Just assume that the conditions of the Theorem hold.

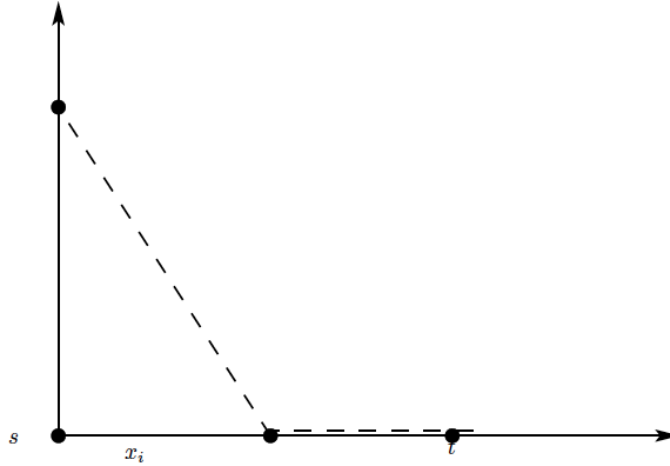


Figure 1: In this variant, for the path back, the agent can move in the free-space.

Exercise 18: Prove the Gal-Theorem conditions (4 points)

For $\theta \in (0, \pi/4]$ we consider the functionals

$$F_k(x_1, x_2, \dots, x_{k+1}) := \frac{\sum_{i=1}^k \sqrt{x_i^2 + x_{i+1}^2 - 2 \cos(\theta) x_i x_{i+1}}}{x_k}.$$

- a) Proof that unimodality holds, i.e.:

$$F_k(A \cdot X) = F_k(X) \text{ and } F_k(X + Y) \leq \max\{F_k(X), F_k(Y)\}$$

holds for $A > 0$ and sequences X and Y .

- b) Make use of the Theorem of Gal and define the function $f(a)$ that has to be optimized for $a > 1$. Try to find a simple representation of f .