Online Motion Planning, SS 16
Exercise sheet 6
University of Bonn, Inst. for Computer Science, Dpt. I

- *You can hand in your written solutions until Wednesday,* 01.06., 14:15, *postbox in front of room E.01 LBH.*

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

a) Present an example where strategy Bug1 beats the strategy Bug2 w.r.t. path length.

b) 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.

a) Describe a reasonable strategy and its local worst-case situation by functionals in analogy to the standard 2-ray case.

b) Find the optimal strategy by application of the Theorem of Gal. Just assume that the conditions of the Theorem hold.

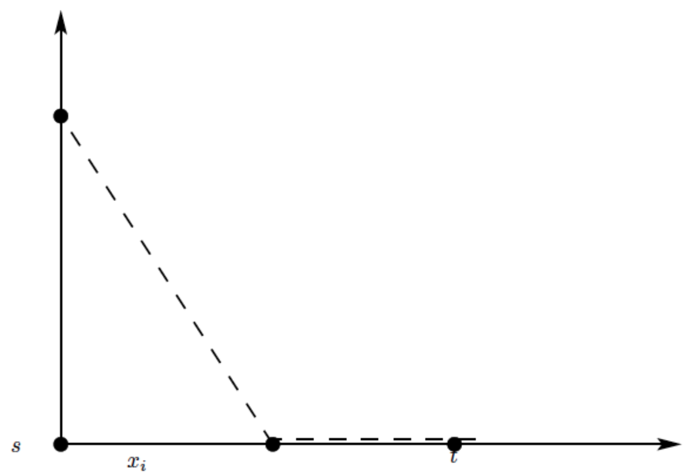

Figure 1: In this variant, for the path back, the agent can move in the free-space.

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

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

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

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.