Online Motion Planning, WT 13/14
Exercise sheet 7
University of Bonn, Inst. for Computer Science, Dpt. I

- *You can hand in your written solutions until Tuesday,* 10.12.*,* 14:15*, in room E.06.*

Exercise 19: Star-shaped streets (4 points)

A Polygon P is called *star-shaped*, if there is at least one point p in P that can see every other point q in P. The set of all those points p in P is called the *kernel* of P.

Let P be a star-shaped polygon. Prove that for every point s on the boundary ∂P of P there is a point $t \in \partial P$ such that (P, s, t) is a street.

Exercise 20: Streets and angular bisectors (4 points)

We consider the following simple strategy for finding the target point t inside a street (P, s, t).

Given a triangle defined by the three points p (the current position), v_l and v_r (as defined in the lecture), the robot moves along the *fixed* angular bisector until either v_l or v_r changes. In Figure 1, the robot moves in direction from point p to point z, until v_r changes at point p'.

Analyse the competitive factor of this simple strategy inside *one* triangle, defined by three points p, v_l, v_r (point t is hidden just behind one of the two vertices v_l and v_r), assuming $p = s$ is the starting point.

Please turn the page!

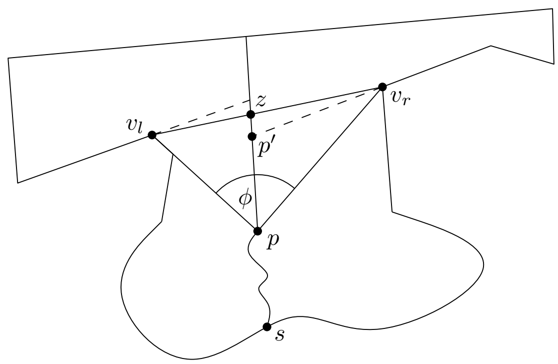

Figure 1: Moving along the angular bisector of the current triangle.

Exercise 21: Angle Hull (4 points)

Let D_1 and D_2 be two disks bounded by two circles C_1 and C_2 in the plane, where $D_1 \subset D_2$. Let $r_1 < r_2$ denote the radius of C_1 and C_2 respectively; compare Figure 2. The *angle hull* of D_1 is the set of points in D_2 that can

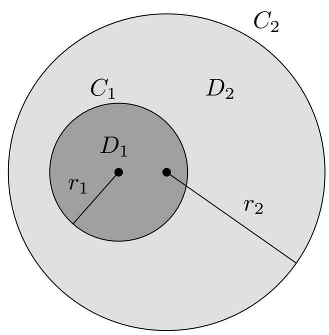

Figure 2: Two disks D_1 and D_2 in the plane.

see two points of D_1 at a right angle.

1. Assuming circles C_1 and C_2 are concentric, what is the boundary of the angle hull of D_1?
2. Give a formal description of the angle hull of D_1 and its boundary, if C_1 and C_2 are not necessarily concentric.
3. Prove that the perimeter P of the angle hull of D_1 is less than $2\pi\sqrt{2}r_1$ and also less than $2\pi r_2$.