COMP 648: Algorithmic Motion Planning
Fall 2005-06

Homework III
due Tues. Oct. 4 in class

Cspace obstacles in (x, y, θ)-space All problems below deal with the following situation:

Obstacle B is a rectangle with vertices at $b_1 = (-2, -1)$, $b_2 = (1, -1)$, $b_3 = (1, 1)$, $b_4 = (-2, 1)$.

The moving object A is a triangle. Initially, its *negation* $(-A)$ has vertices located at $a_0 = (0, 0)$, $a_1 = (\sqrt{3}, 0)$, $a_2 = (0, 1)$. The reference vertex is a_0. The reference line for both A and $(-A)$ is the line segment $[a_0, a_1]$. (Notice that this segment, which is an edge of $(-A)$, hangs off object A.)

1. List all the critical angles.

2. Inside each of the two "slices" of the C-space obstacle that have a boundary at $\theta = 0$, list the formulas for the vertices and edges of the $\theta =$ constant cross-sections in terms of b_1, b_2, b_3, b_4, $a_0(\theta)$, $a_1(\theta)$, and $a_2(\theta)$.

3. Calculate the minimum volume axis-aligned enclosing box for the C-space obstacle slice between $\theta = 0^o$ and $\theta = 30^o$.

4. Find a (non-trivial) smaller box inside the minimum enclosing box that lies entirely inside the C-space obstacle. Prove this is so by using the tests described in class. (This is somewhat open-ended, since you have to choose the box.)

5. Repeat for a box lying entirely outside the C-space obstacle. (Likewise, here, you choose a box.)

Note: The main purpose of these problems is to understand the nature of the the C-space obstacle for the situation described; in particular, to see how the tests for boxes work in the context of a specific example. To do this involves some computations. However, the point is not the lengthy computations, but rather to understand how to do them and interpret the results.

Suggestion: Work together with a class-mate(s). Share the work of doing the tests. When you hand in your homework, please note down with whom you worked. Your write-up should be your own.