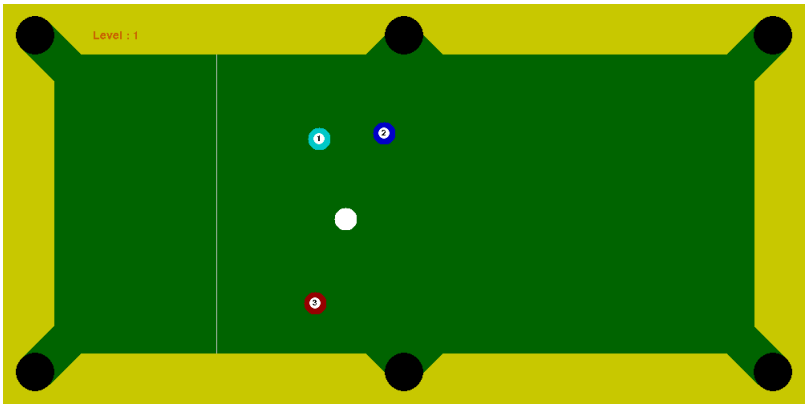
CS 747 Assignment 3
Optimal Cue-stick Control

Amruta Mahendra Parulekar, 20d070009

November 5, 2023



1 Solution

1.1 Basic solution : Head on collision of closest ball

- The first thing I tried was to make the white ball have a head-on collision with the nearest ball to it.
- The aim was to just get started, and this seemed the most logical first step, as for the closest ball, the error in the angle will not matter as much, and with increase in distance, error angle will have a higher effect.
- I started out with setting the force as 0.5, because a very small force would not even let the white ball reach the other ball and a very high force will lead to a high stochastic error angle.
- Then I observed the simulation and realised that 6-7 test-cases were passing already with this strategy.
- I tried increasing the force to see that it performed better with higher force, as there were more collisions and the chance of the ball going inside at some point was higher with more collisions.
- At 0.9 force, I was getting best results and with more force than this, the random error of the angle was too high and more test-cases were failing.

1.2 Improvement 1 : Balls close to holes

- On watching a few simulations, I realized that there were some points when a ball was very close to a hole and if that ball had been preferred over others, it would have gone into the hole immediately.
- So I wrote an if-else case, where if any ball is withing a certain radius of a hole, then such balls are appended to an array and of all these, the ball with the least distance from the hole is hit on priority over the nearest ball to the white ball.
- On watching the simulation again, I realized that this was happening even when the white ball was placed such that on hitting the ball close to the hole, it was driving the ball further away from the hole.
- So i placed another condition that the balls close to holes will only be considered if the hole close to it and the ball considered are in the same quadrant with respect to the white ball as origin.
- This means that the white ball would push the ball close to the hole and not away from it.
- Then I fine-tuned this radius to get best results at radius 60.
- I also thought that these balls close to holes should be hit lightly to make them enter the hole, so I tried giving a lower force to them, but that worsened the results so I gave 0.9 force to all cases in the end.

1.3 Improvement 2 : Balls collinear with holes

- On watching some more simulations I realized that sometimes balls lie in almost the same direction from the white ball as the holes. i.e. the white ball, a colored ball and a hole are collinear.
- To find such cases, I calculated the angles of all holes from the white ball and the angles of all balls from the white ball.
- If the difference between the angles of any ball and any hole from the white ball is less than a threshold (fixed at 0.006 after trials), we can say that the ball and hole are almost collinear with the white ball (exact collinearity not possible, very rare)
- On identifying such cases, I found the most collinear case (angle difference smallest) and ensured that it was hit on priority over both the closest balls and the balls very near holes, because it is most surely going to go inside the hole.
- Such cases need to be handled with the most precision, so I reduced the force a bit, to 0.6, to increase the angle accuracy of the shot