Robotic Results

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Problem domain

My goal in this project is to develop a control system for a robotic arm that will allow me to make it pick up pieces from a tray of letters and spell out a word on a Scrabble board. I will tell the robot which letters in its tray form the word I want it to play and the location on the Scrabble board of the start of the word. The arm will pick up the pieces and place them on the Scrabble board in their proper locations without disturbing the other pieces on the board.

Thus the problem domain is all possible boards and placement commands. The range is the sequence of movements necessary to place the specified piece on the board.

High-level description

To implement this problem, I broke the high-level problem of placing pieces on the board into may smaller pieces that accomplish sub tasks. Then I combine sub tasks together in a top up function until the original problem has been solved. The implemented function are listed below, from low to high level.

- float GetX(float col), float GetY(float row)
  Make a base/offset calculation to convert from (x,y,z) in Rhino space to (r,c) in scrabble space

- void PlacePieceOnBoard(int row, int col, int orien)
  Assumes that the gripper is holding a piece; places the piece on the board at location (r,c) with orientation given in orien.

- void PushBlock(int row, int col, int direction)
  Attempts to push a piece onto the square in direction direction.

- void GetPieceFromTray(int number)
  Pick up a piece from the tray of letters by its top side.

- void HoldPiece(int orien)
  After picking a piece up from the tray, regrasp it so that it is held flat-ways.

- int ChooseOrient(int row, int col)
  Based on the world map and desired row/col, pick the proper orientation.

- int main(int argc, char **argv)
  A command handler that calls the above functions.

The source code also contains several #define statements that define the location of the board and other constants.

Evaluation

The robot is able to place pieces on the board with an accuracy of +/- one piece. Is this a success? I believe that I've come very close to achieving the best accuracy given no feedback. So, I think I have succeeded. I've developed a system that comes very close to placing a piece in the correct location.

I did meet my goals in that the robot does its best to put the pieces on the board. The robot successfully picks a piece up from the tray by the top edge and the switches its grasp to a flat-ways hold. I'm happy with this performance.

Finally, I've learned that no world is completely fixed. The Scrabble environment seems very right. However, a control system with no feedback is unable to perform exactly. Even is this rigid, structured environment, a world map cannot be trusted.