A software tool named the "Kitting Viewer" has been developed that simulates the execution of a plan (CRCL command file) for changing a kitting workstation from an initial state to a goal state. Usually, that is a plan for making one or more kits. The Kitting Viewer evaluates the plan as it runs. The Kitting Viewer source code is in C++ with OpenGL graphics.

Overview

The Kitting Viewer reads files describing the initial state, the goal state, and the plan for getting from the initial state to the goal state. Optionally, it also reads a scoring file. If no scoring file is specified by the user, a hard-coded default scoring file structure is used. The Kitting Viewer simulates execution of the plan, displays a view of the plan being executed, and produces and displays metrics about the plan. All of the metrics are numbers. All but one of the metrics are objective and require no human judgement. These metrics are presented in Section sect:Metrics. The final metric is a subjective combination of the other metrics in which the other metrics are weighted and combined as specified by the scoring file. The scoring file may be edited as desired by the user. Scoring details are given in Section sect:Results.

The Kitting Viewer runs in two phases. In the first phase, each time the user gives a signal (presses the `g` key) the next command from the command file is executed. The Kitting Viewer may decide that a command cannot be executed, but if it decides a command can be executed, it assumes the command is executed properly. In the second phase, which starts after all commands have been executed, each time the user gives a signal the position of the next movable object in the goal file is checked.

Figure fig:KittingViewer shows the Kitting Viewer windows as they look after a test run has been completed. The display uses three windows, labeled Metrics & Settings, Kitting Viewer, and Kitting Command & Messages. The windows may be moved and re-sized independently, like other windows in a typical windowing system.

In Figure fig:KittingViewer, the large blue object is a work table. The small blue object is the end effector changing station. The three empty small green boxes are parts trays that formerly held parts. The large green box on the left is a container for completed kits; it contains one kit. The large empty green box on the right formerly held an empty kit tray.

The Kitting Viewer window shows a 3D animated color view of the kitting workstation. The floor of the workstation is covered with a grid. The robot in the workstation is represented by a gantry robot spanning the entire width of the workstation. The gantry robot moves when any CRCL motion command is executed. The speed at which the picture of the robot is animated matches the actual commanded speed of the robot. Objects in the workstation move if the robot moves them. The view in the window may be translated, rotated, or zoomed at any time.

In the first phase of running the Kitting Viewer, the Kitting Command & Messages window shows the currently executing command or the most recently executed command, if no command is currently executing. In the second phase, the window shows messages describing success or failure in locating goal objects.

The Metrics & Settings window shows 12 (first phase) or 15 (second phase) metrics at the top. Below that it shows 13 robot settings and two Kitting Viewer settings. All but two of the robot settings correspond to items that may be set using CRCL commands. The extra two are the robot's maximum speed and maximum acceleration, which may not be reset. As commands are executed, metrics and settings are updated in the window. figure[ht!] center [width=8.5cm]images/kittingViewer2013Feb23.jpg Kitting Viewer Display fig:KittingViewer