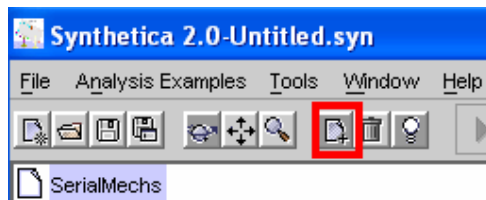


2004 ASME DETC Tutorial

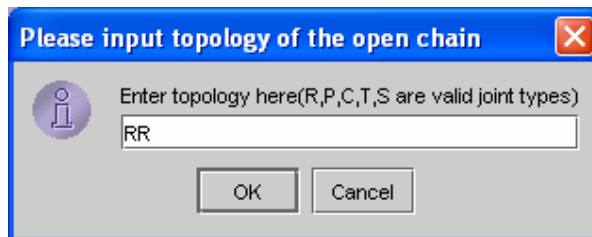
Robot Design using Mechanism Synthesis Theory

Project 2: Computer-aided Mechanism Synthesis of spatial serial chains Demonstration exercise using Synthetica 2.0

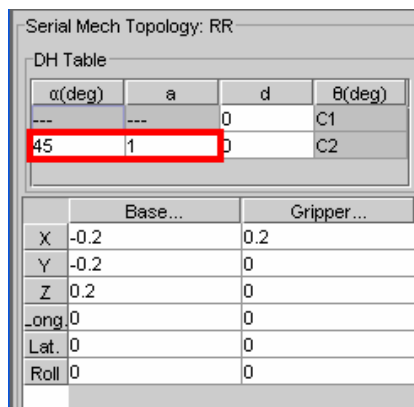
1. Creating a RR serial mechanism
 - a) Click the “SerialMechs” icon in the left tree structure
 - b) Click the “Add” button on the toolbar



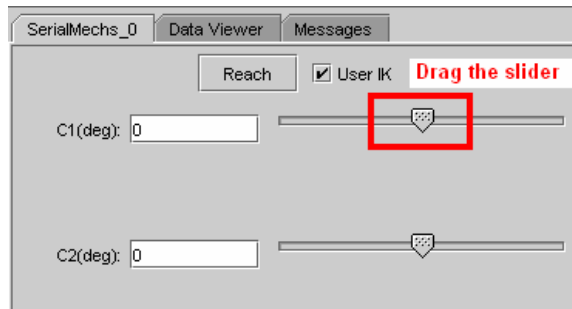
- c) Input “RR” as the topology in the dialog box



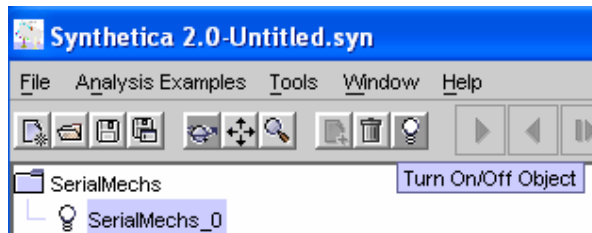
- d) Change the twist angle (alpha) and link length(a) to be “45” and “1”.



- e) Drag the slider bar to experience the built-in forward kinematics



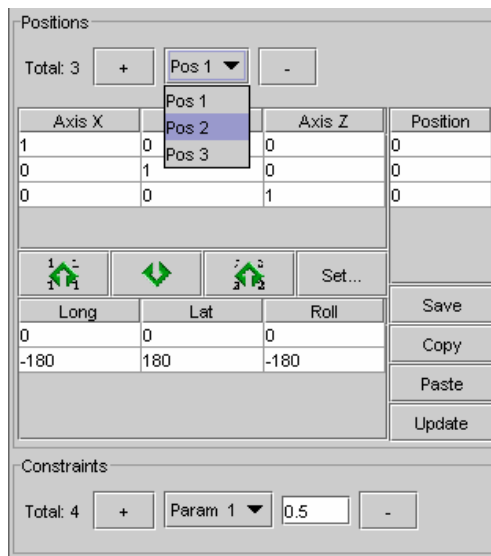
- f) Select the “SerialMechs_0” and click bubble icon on the toolbar to turn off the RR chain



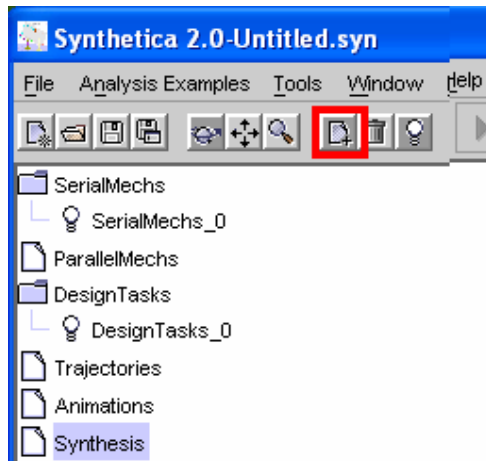
- g) Select menu “File->Save” to save the file

2. Special synthesis routines (RR 3 position synthesis)

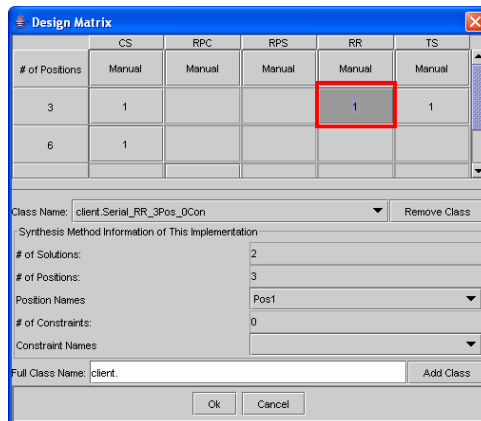
- a) Select the node “DesignTasks” in the left tree structure and click the “Add” button on the toolbar to create a design task (see Appendix to understand the design task)
 b) Modify the default task



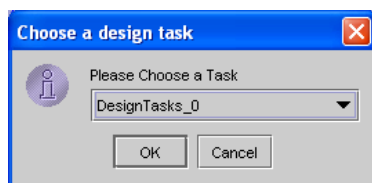
- c) Select “Synthesis” node in the object tree and click “Add” button on the toolbar



- d) When the DesignMatrix dialog appears, select the RR 3 position synthesis routine and click “Ok” button



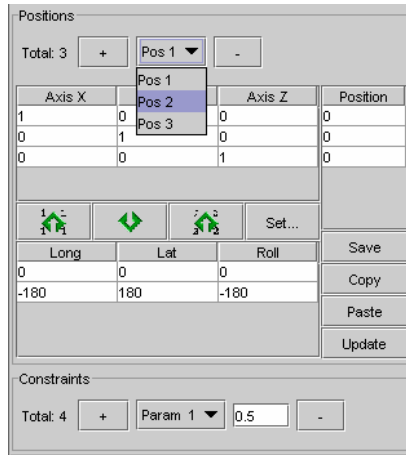
- e) Select the design task



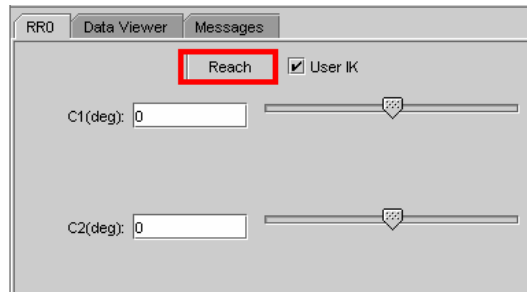
- f) The two solutions are listed under “SerialMechs” node



3. Execute inverse kinematics
 - a) Select one of the two RR serial chain solution
 - b) Select the “DesignTask_0”
 - c) Pick one position in the task



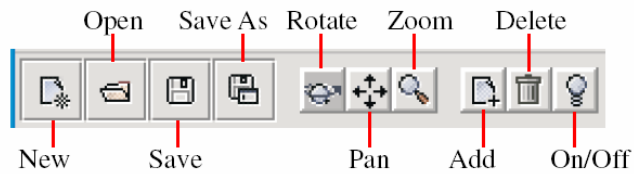
d) Click “Reach” button in the Teach panel



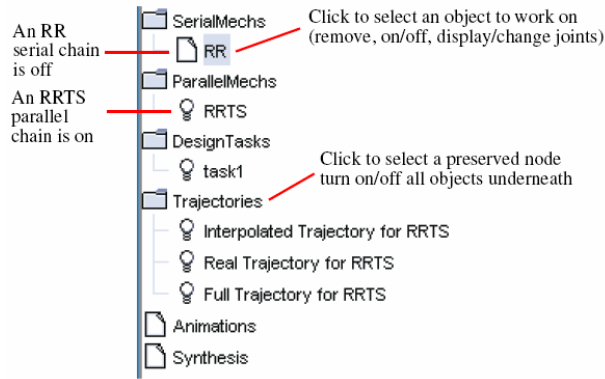
4. The General Synthesizer is accessed by deselecting all synthesis routines in the Design Matrix and click “Ok” button

Syntheticca 2.0 Guide.

1. Toolbar Icons



2. The object tree structure



3. The Option dialog box

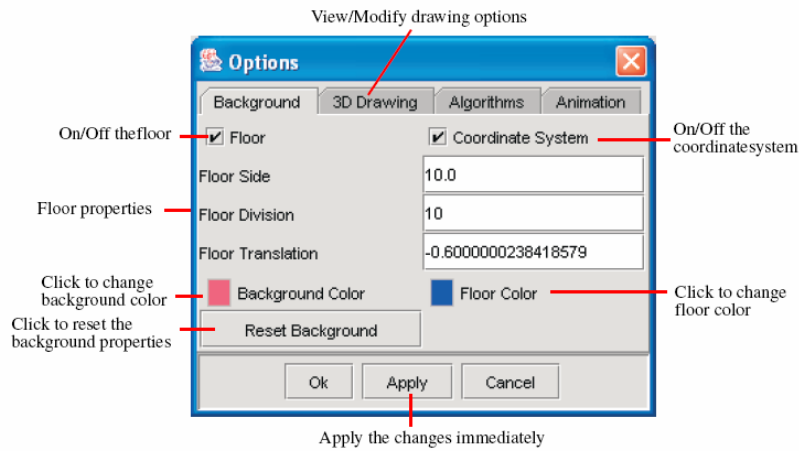
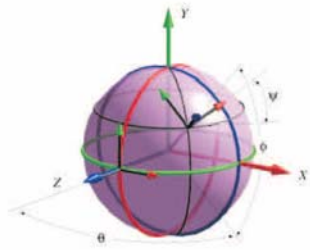


Figure B.3: The option dialog

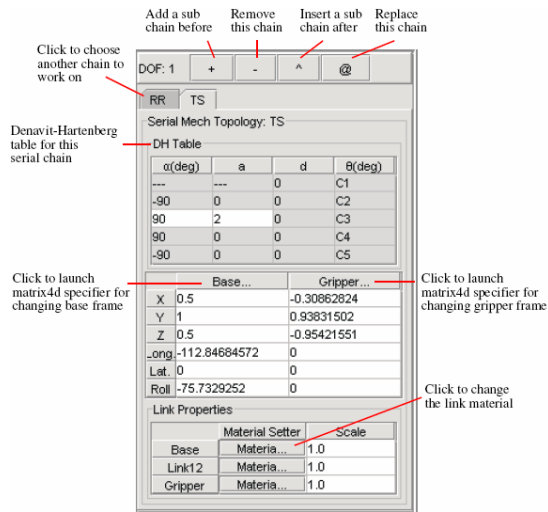
4. Understanding Longitude, latitude and roll for representing rotation matrix



$$[R(\theta, \phi, \psi) = [Y(\theta)][X(-\phi)][Z(\psi)]$$

$$= \begin{bmatrix} c\theta c\psi - s\phi s\theta s\psi & -c\psi s\phi s\theta - c\theta s\psi & c\phi s\theta \\ c\phi s\psi & c\phi c\psi & s\phi \\ -c\psi s\theta - c\theta s\phi s\psi & -c\theta c\psi s\phi + s\theta s\psi & c\phi c\theta \end{bmatrix}$$





5.

6. Design task specifier

