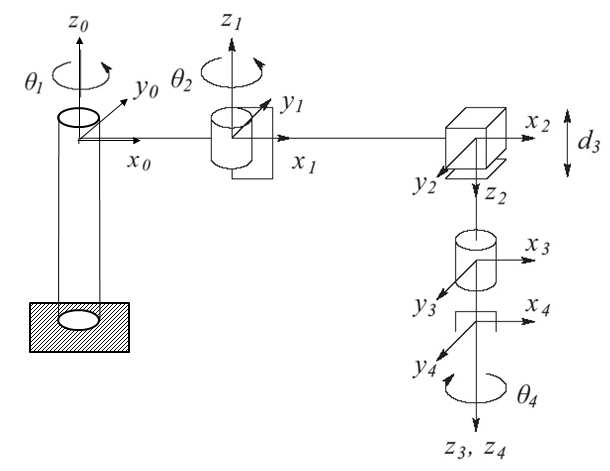
**Homework – Inverse Kinematics**

In lab and lecture, the inverse kinematics of a 2-DOF planar manipulator were derived and demonstrated.

1. Reconfigure the original 2-DOF planar manipulator such that Link 1 is a Beam 7 and Link 2 is a Beam 9 and appropriately change in **xl320-ik-1\_0.nxc**. Affix four green-colored 1-stud bricks at points that reflect , where and are angles of Link 1 and Link 2 respectively.
2. URL to your YouTube video demonstration (20-points)
3. All files (e.g. NXC and Headers). Comment and make readable i.e. make good use of white space (10-points)
4. Recall the DH parameters for the SCARA arm given below and you previously derived.



|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Link |  |  |  |  |
| 1 |  | 0 | 0 |  |
| 2 |  | 180 | 0 |  |
| 3 | 0 | 0 |  | 0 |
| 4 | 0 | 0 |  |  |

\* denotes variable

The general problem of inverse kinematics is given a homogeneous transformation find a solution (possibly non-unique) for where. In other words, is the desired end-effector pose and one needs to find joint variables so that. If say that where is the end-effector position and is the end-effector orientation.

1. Use the figure below and the Law of Cosines to show that where (5-points)
2. Show that ) (5-points)
3. Given that show that (5-points)
4. Show that (5-points)

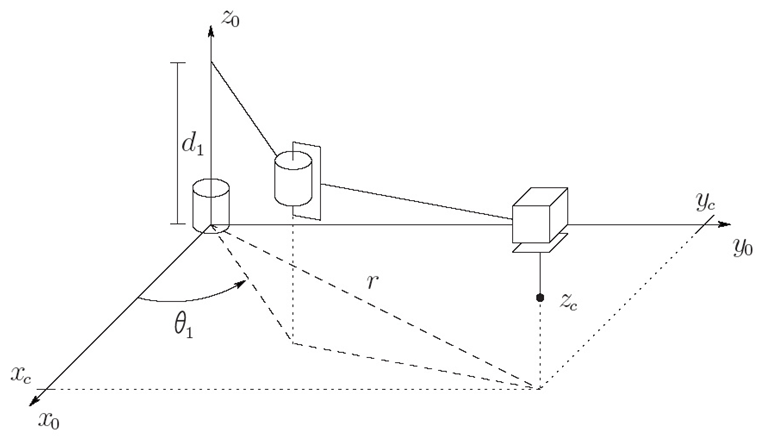


Figure: Configuring the SCARA as above, and projecting the manipulator onto the plane shows that one can apply the Law of Cosines to show