DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING
UNIVERSITY OF TEXAS AT ARLINGTON
INTRODUCTION TO ROBOTICS - ME 5337
PROJECT #2
DUE DATE: TWO CLASS MEETINGS FROM ASSGINED DATE
TOPIC: REAL WORLD APPLICATION OF
COMPOUND TRANSFORMATION/TRANSFORM GRAPH EQUATION

The following narrative describes the experimental robotically automated surface finishing (RASF) cell in operation at UTA. This cell was envisioned and setup to accommodate various workpieces that require surface finishing operations. The nature of the workpieces –size, general outline, material, etc. – dictated the development of an idea that we call SOFT TOOLS. Soft tools are used in a robotic environment in lieu of hard automation and fixtures. One can envision that a worker arbitrarily positions a workpiece in the cell –of course the workpiece should be reachable by the robot – and through the use of software and sensors calibrates the workpiece relative to the robot. Subsequently, a custom developed off line programming system develops the robot program considering all the process requirements.

The RASF cell consists of an S-400 robot and its controller, a FARO coordinate measuring machine (CMM), several workpieces, the RobSurf software that runs under AutoCAD R 12 and developed in AutoLisp. The following pictures show the general cell layout and close ups of the various components. . The soft setup capability is implemented in the RASF cell through the use of a coordinate-measuring device calibrated with respect to the robot tool plate. Subsequently, the end effector is attached to the robot tool plate. Note that the transformation that relates the end effector operating point relative to the tool plate is known.

Project Requirements
- Your task is to identify all the necessary transformations for soft setup capability and describe their relationship, i.e. develop the transform graph and find the transformation that relates points on the workpiece to the robot reference frame and the end effector.
- Develop a schematic that shows all hardware pieces and the frames needed (attached to the hardware pieces) for solving this problem.
- You are to develop a parametric/general purpose computer program that will perform all the computations and present the user with the pose and coordinates of the points with respect to the robot reference frame.
  - INPUTS:
    - Parametric inputs will be the DH parameters for the robot
    - The tool offsets relative to robot tool plate
    - The DH parameters of the CMM
    - The location of the robot base and CMM base
    - The stream of points scanned by the tip of the CMM (relative to CMM base)
  - OUTPUT:
    - The stream of points relative to the reference frame, relative to the robot tool point and relative to the end effector.

You must turn in along with your report a floppy with the report and all the software – executable if not matlab - and instructions on how to use it in a batch mode. The input file must contain the robot definition parametrically and then evaluate all the above required elements.