The George W. Woodruff School of Mechanical Engineering
Georgia Institute of Technology
Homework #1 Transformations & Parametric Modeling Due: Jan. 25
ME 6104 Fundamentals of Computer-Aided Design Spring 2005

LEARNING OBJECTIVES FOR RIGID-BODY TRANSFORMATIONS AND CAD:

- Learn the principles of rigid-body transformations (translation, rotation, scale), including how to model an artifact using combinations of these transformations.
- Learn the basics of primitive instancing, including how to model artifacts from a small number of more fundamental shapes.
- Learn the principles of parametric modeling and how to construct parametric models using geometric entities, constraints, and datums. Know how to select an appropriate parametric modeling scheme.

In this assignment, we will study the elevator mechanism in a stereolithography machine, the SLA-250. In particular, we will investigate rigid-body transformations, primitive instancing, and parametric modeling through the modeling of the elevator, shown below. Basically, the platform translates vertically along the parallel shafts, driven by a lead screw. The platform can also rotate about a hinge with the slide (for removal purposes). You are to create a model of the elevator in Matlab and in a solid-modeling, parametric modeling CAD. See the figures on subsequent pages for a picture of the elevator, including dimensions to be adjusted (called **parameters**).

1. (40 points) MATLAB Create a parametric model of the elevator mechanism, as shown below, in MATLAB. Use the parameters shown in the figure as the top-level variables. Define the geometric entities using cubes that are scaled, rotated, and positioned appropriately using transformation matrices. Note the global coordinates at the bottom, center of the SLA machine. Embed your parametric relationships into the transformation matrices. Utilize Roll-Pitch-Yaw transforms as we discussed in class to control viewing.

Create a local coordinate system, called Lift, near the right side of the Top Mount component. Lift is to be positioned relative to global coordinates. The X coordinate of the Lift coordinate system is given by: LiftX = -0.5*B + 0.5*G + 0.2, where the parameters are given in the table below.

Position the Vat relative to global coordinates. Vat Z is defined as: VatZ = 40 – C.

The lead screw will be collinear with the Z axis of the Lift coordinate system. Position the lead screw, the shafts, the slide, and the bottom mount in Lift coordinates. Shaft diameters are 1 inch.

Position the platform relative to the slide, then position the workpiece relative to the platform. The workpiece should be 4x6x3 inches.

a. Derive parametric relationships that control the size and position of each geometric entity (cube) in the model. **In a brief report, present and describe how you modeled the elevator mechanism**. Provide sketches, equations, and descriptions of how you sized and positioned the various shapes that comprise the mechanism using slides 17-20 from Module 5 as an example.

b. Develop a MATLAB model of your elevator that utilizes these parametric relationships. **Turn in a documented listing of your program.**

Plot (and turn in) views of your elevator for the following values and views. Views are given as Roll, Pitch, Yaw. Assume reasonable values for any unspecified dimensions.

	A	B	C	D	E	F	G	H	θ	Roll	Pitch	Yaw
c.	11.5	11	12	0	8	8.5	2	2	0	0	0	0
d.	11.5	11	12	-3	8	8.5	2	2	0	0	0	-90
e.	11.5	11	12	1	8	7.5	2	2	30	-20	-30	-80
f.	15	16	16	3	10	8.95	2	2	30	-20	-30	-80

2. (20 points) Construct a model of the elevator in your favorite parametric modeling CAD system (ProEngineer, IDEAS, SolidWorks, SolidEdge, etc.). Construct your model using as many parts as you need/want, but it is not necessary to specify assembly relationships between these parts for this homework assignment. Parameterize your model in the same manner as in (1). Turn in **THREE** images of your model that are similar to the views and sizes of: **1.c.** and **1.f.** plus **one additional view** of your choice.