1023-J1-1918   **Helmer Aslaksen*** (`aslaksen@math.nus.edu.sg`), Dept. of Math., National University of Singapore, Singapore, 117543. *Using gimbal lock in 3d programs to illustrate linear algebra Concepts.* Preliminary report.

I have recently started using 3d programs like Poser or the free DAZ Studio to illustrate concepts in linear algebra. It all started when I experienced the phenomenon of Gimbal lock (know from the movie Apollo 13). A rotation, $R(V, s)$ by s counterclockwise around vector V can be written as $R(Z, a)R(X, b)R(Y, c)$, where a, b and c are the Euler angles corresponding to rotations around the global Z, X and Y axes.

When experimenting with Poser, I discovered that when I change the Z-angle a to $a + d$, I get a global Z-rotation of d, but if I change the Y-angle c to $c + d$ I get a local Y-rotation of d. If I change the X-angle from b to $b + d$, I get a global rotation of d, but not around the X-axis but around the axis that results when you apply $R(Z, a)$ to the X-axis.

This combination of local and global axes can lead to gimbal lock. If you start with a rotation by $pi/2$ around the X-axis, the local Y-axis and the global Z-axis coincide. This means that I now only have two rotation axes to use, and I will not be able to represent all rotations.

When experimenting with the program or reading the manual, this seems very strange. However, when I interpreted it in terms of matrix multiplication, it all made sense, and became a very instructive exercise in linear algebra, suitable for a first course. (Received October 04, 2006)