

Maths for cube.c

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I recommend checking the Donut script and the PDF file first for a better understanding of the concepts, before reading this one, which is only a small part of the Donut script applied to the moving cube.

Rotations applied to the cube

This short note presents two rotation matrices in R^3 and their composition. We work in a right-handed Cartesian coordinate system with positive angles following the right-hand rule.

Let

$$v = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$$

be a vector in Cartesian coordinates.

Rotation about the X -axis

The rotation matrix that rotates a vector by an angle A about the X -axis is

$$R_x(A) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos A & -\sin A \\ 0 & \sin A & \cos A \end{bmatrix}.$$

Rotation about the Y -axis

The rotation matrix that rotates a vector by an angle B about the Y -axis is

$$R_y(B) = \begin{bmatrix} \cos B & 0 & \sin B \\ 0 & 1 & 0 \\ -\sin B & 0 & \cos B \end{bmatrix}.$$

Composition: $R_y(B) R_x(A)$

We apply first a rotation by A about the X -axis, then a rotation by B about the Y -axis. The composed transformation is

$$v' = R_y(B) R_x(A) v.$$

So we obtain:

$$v' = \begin{bmatrix} x' \\ y' \\ z' \end{bmatrix} = \begin{bmatrix} x \cos B + (y \sin A + z \cos A) \sin B \\ y \cos A - z \sin A \\ -x \sin B + (y \sin A + z \cos A) \cos B \end{bmatrix}.$$