

NanoEngineer-1 Gallery: Strained-shell Sleeve Bearing from Nanosystems

Name: Strained-shell Sleeve Bearing
Designer: K. Eric Drexler
Date: 1994
Number of components: 2
Number of atoms: 2,808
Diameter: 4.2 nm
Width: 1.2 nm

This is the strained-shell sleeve bearing from Nanosystems (page 296) designed by K. Eric Drexler and Ralph Merkle while they were working together at Xerox PARC. The model comprises two molecular components; the inner shaft and the outer sleeve and contains a total of 2,808 atoms.

With practice, an experienced user can create this bearing in 10-15 minutes. NanoEngineer-1 includes an extrusion tool for creating rods and rings from a molecular fragment (called a chunk in NanoEngineer-1).

The contraption with spokes connected to the inner shaft is called a rotary motor. This is a type of jig in NanoEngineer-1 that applies torque to the atoms to which it is attached during a molecular dynamics simulation, driving the inner shaft. The rotary motor here had a torque setting of 100 nN-nm and a speed of 500 GHz. These values are extreme and were used to produce an interesting simulation as quickly as possible. A serious engineer assessing the operating conditions of this bearing would have used more reasonable numbers.

The black boxes (visible in the top image) are constraints called anchors and are attached symmetrically to atoms around the outer sleeve. Anchors are used to hold individual atoms in place during a molecular dynamics simulation.

To setup the molecular dynamics simulation, I used the following parameters:

- Frames: 1500
- Steps per frame: 200 (20 femtoseconds)

- Temperature: 300K

NanoEngineer-1 has a full-featured movie player that allows the simulation to be played in forward and reverse, paused, or restarted from the beginning. While the movie is playing, it is possible to rotate, pan and zoom the model interactively. Other useful features include the ability to select and change the display mode of different parts of the model (while the movie is paused) and then continue playing the movie.

This image was rendered in POV-Ray after exporting the sleeve bearing model as a POV-Ray file. This is one of many features that make NanoEngineer-1 an excellent tool for creating professional looking graphics for use on web sites and publications.