Deutsches Zentrum
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Background information

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Control and monitoring of satellites in space

We are standing in Control Room K1 at the German Space Operations Centre (GSOC) in Oberpfaffenhofen From here, we typically take charge of missions when a satellite is released from the rocket that delivered it into space. At the present time, we are supporting the satellites TerraSAR-X and TanDEM-X, TET and, of course, the European Columbus module on the International Space Station (ISS). To enable satellites to point in a specific direction, I must enable their position control systems. Satellites can also be manoeuvred in space using angular momentum gear or jet thrusters. To change orbit, I need to activate the propulsion units and deliver some real thrust. The whole operation is monitored by what is known in the trade as telemetry, in which the satellite uses radio waves to transmit a continuous stream of data back to us about temperature, pressure, and valve position settings. All of that is displayed down here on our viewing screens, and is then evaluated accordingly.

As long as a satellite is functioning, or is still being operated actively, I have radio contact with it at all times through our ground stations. At the end of the missions, satellites are usually shut down completely, run out of fuel, lose their ability to maintain their position, have solar cells arrayed in the wrong direction to receive sunlight, or have batteries that have discharged completely. ROSAT is currently in this category; it was shut down a good 10 years ago, and we are simply unable to direct it any longer. Even if we were able to do so, it no longer has any fuel on board to enable it to return to Earth in a controlled manner.

Although it is possible to measure the position of ROSAT very accurately with the help of radar stations, the precise timing of its re-entry depends on solar activity, and on atmospheric density. Typically, the fluctuations in these factors are so pronounced that it is not possible to predict when re-entry will actually occur until just a few orbits beforehand. Moreover, the uncertainty is so great that, essentially, anywhere along the entire orbital range covered by the satellite could be affected when it returns to Earth.

We are now in the EPOS building, home to a simulation system which enables us to simulate and test the approach and docking of one satellite to another. Primarily, DLR is conducting research into two different types of mission: firstly, the docking operation to a geostationary satellite, similar to the one you can see here behind me. These satellites are always equipped with what is known as an apogee motor with which it was originally placed into orbit. It is possible to grip this motor with a robot to dock the satellite as a preliminary to extending the service life of the satellite through the delivery of new fuel.

The second mission being investigated by DLR is the DEOS mission. The objective here is to use a robot arm to capture a satellite in erratic, ‘tumbling’ orbit, to slow it down and then to crash-land it in a controlled manner.

The unique feature of the EPOS system is that we are able to simulate contact dynamics. In other words, to simulate the actual movement of a satellite while docking, rotating away under conditions of zero gravity, its tumbling action, and the forces exerted at the time. All of this can be tested in advance to determine how robust the satellite ‘build’ needs to be.