

Chapter 1

Introduction

This chapter presents examples of antennas and telescopes, shortly describes the antenna control system, and presents references on the antenna mechanical and control engineering.

1.1 Examples of Antennas and Telescopes

1.1.1 NASA Deep Space Network

The NASA Deep Space Network (DSN) antennas communicate with spacecraft by sending commands (uplink) and by receiving information from spacecraft (down-link). To assure continuous tracking during Earth's rotation, the antennas are located at three sites: Goldstone (California), Madrid (Spain), and Canberra (Australia). The signal frequencies are 8.5 GHz (X-band) and 32 GHz (Ka-band). The dish size of the antennas is either 34 m or 70 m. An example of the 70-m antenna is shown in Fig. 1.1. The antenna dish rotates with respect to the horizontal (or elevation) axis. The whole antenna structure rotates on a circular track (azimuth track) with respect to the vertical (or azimuth) axis. For the Ka-band frequency the required tracking accuracy is on the order of 1 mdeg. This requirement is a driver for the control system upgrade of the antennas. In [2], [3], and [4] you can find the description of the DSN antenna control systems, and at the webpage <http://ipnpr.jpl.nasa.gov/index.cfm> the DSN antennas research reports, including control systems. The Deep Space Network webpage is at the webpage deepspace.jpl.nasa.gov/dsn/.

1.1.2 Large Millimeter Telescope

The Large Millimeter Telescope (LMT) is the joint effort of the University of Massachusetts at Amherst and the Instituto Nacional de Astrofísica, Óptica, y Electrónica (INAOE) in Mexico (Fig. 1.2). The LMT is a 50-m diameter telescope, designed for operation at wavelengths between 1 mm and 4 mm. The telescope rotates with respect to elevation and azimuth axes. It is built atop of Sierra Negra