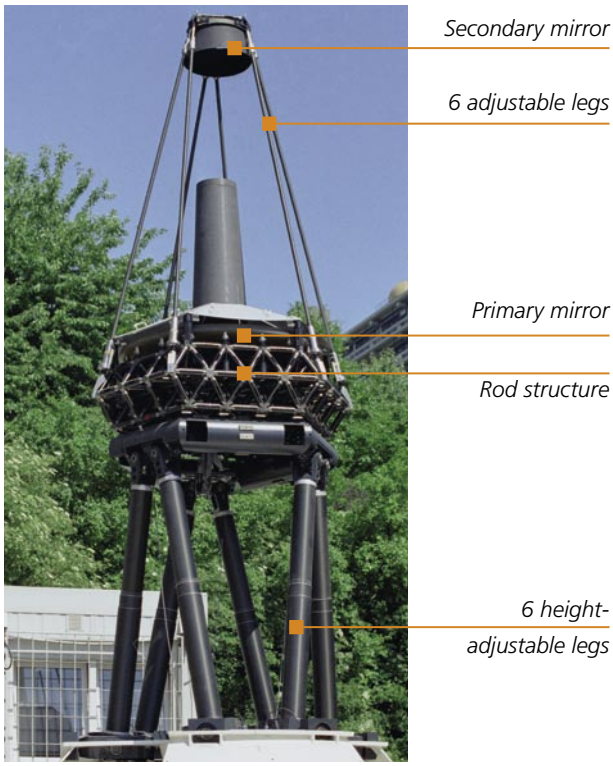
Astronomical Research in Chile

- Ruhr University at Bochum researches in Chile
- DS1103 PPC Controller Board controls a telescope
- Studying the development of young stars and quasars

Telescopes in the Atacama Desert in Chile are jointly maintained by the Astronomisches Institut at the Ruhr University in Bochum, Germany (AIRUB), and the University of Antofagasta. Research there mainly concentrates on the development of young stars and energy bursts in quasars. Soon there will be three more telescopes, including an innovative hexapod telescope, turning the complex into a sizable observatory. A DS1103 PPC Controller Board is used to control the hexapod telescope's movable legs.

Building an Observatory

AIRUB's telescopes are an impressive observatory. One of the new additions currently being erected in Chile is a hexapod telescope (HPT), funded by the Economics Ministry of Northrhine-Westphalia in Germany and built by Krupp Industrietechnik. It will be joined by a 40-cm robotic telescope that was completed in Bochum in March 2005. A 90-cm robotic telescope will be completed in 2006. The purpose of the observatory is to detect changes in young stars and quasars in the visible and infrared ranges.



▶ *The hexapod telescope (HPT) – seen here still in the Botanical Gardens in Bochum – is being constructed in the Atacama Desert in Chile to study young stars and quasars.*

The Hexapod: A New Kind of Telescope

The HPT has 6 height-adjustable legs (hence the name hexapod) with high-precision spindles that keep the telescope trained on a target object, adjusting for the motion of the stars mainly caused by the Earth's rotation.

The HTP is a prototype with the following technical innovations:

- Mounted on 6 height-adjustable legs
- An actively controlled primary mirror consisting of a thin ZERODUR® meniscus mounted on a rod structure. The mirror is vaporized with aluminum for maximum reflectivity.
- A secondary mirror with 6 adjustable legs to compensate for gravitational deformations due to varying elevations

The primary mirror is 1.5 m in diameter, yet only 50 mm thick – so thin that it would be unable to keep its shape without its 36 computer-controlled mounting points. These bend the mirror to ensure it always has the optimum shape in any telescope position. The optimization process is constantly controlled by an electronic optical system that AIRUB developed with the help of the European Southern Observatory (ESO). The HPT's receivers are a CCD camera and a spectrograph. We planned the spectrograph in cooperation with the Landessternwarte observatory in Heidelberg-Königstuhl, Germany. It enables the HPT to capture and study all starlight across the entire optical spectrum (370 to 1000 nm) in a single exposure.

Advantages of a Hexapod Telescope

The special structure using adjustable legs made it possible to considerably reduce the weight of the telescope. The primary mirror is the first of its kind, with numerous mounting points that allow it to respond to both pressure and tension. This guarantees a constant ideal optical surface. Another computer-controlled support optimizes the position of the secondary mirror. So in a suitable location such as the Cerro Armazones in Chile, and with stable atmospheric conditions, the HPT provides a sharpness of image that is otherwise only possible in space.

▲ *The Observatorium Cerro Armazones (O.C.A.) is a joint project of the Ruhr University at Bochum, Germany, and the University of Antofagasta in Chile. Research is currently being performed on two telescopes.*

Term	Explanation
Azimuth	The horizontal angle from true north of a star or of a point on the Earth's surface
CCD camera (CCD = charge-coupled device)	Electronic camera that collects and reads the electrons that strike each individual pixel. This provides the distribution of light intensity over the surface. Filters are fitted in front of the camera to measure light of specific wavelengths.
Elevation	Angular distance of a point in the sky from the horizontal plane
Quasar (quasi-stellar object)	Highly luminous and usually very distant active galaxy
Spectrograph	An instrument that breaks down the light entering it into its spectral components. This provides the distribution of light intensity as a function of wavelength.

Controlling the Telescope

A DS1103 PPC Controller Board controls the telescope's position. The board is used to read out and control the encoders and servo amplifiers of the 6 adjustable legs, and to compare the telescope's actual position with the desired position. It also controls the HPT's speed. The desired position in terms of azimuth, elevation, and rotation is computed in real time via a CAN bus. The system is loaded from an experiment software environment, which also provides it with parameters.

Research Opportunity

At the Ruhr University in Bochum, we can carry out astronomy research programs that the big international observatories do not have time for. This gives our students the unique opportunity to work on telescopes at an early stage of their university courses – either on site in Chile or using the robotic telescopes on the Internet. The HPT is being installed on site and will be ready in August 2005. The first phase after that will be to test the HPT before it is put to work making astronomy observations.

Dr. Roland Lemke
Astronomisches Institut
Ruhr University, Bochum
Germany

More information on this project: *www.astro.ruhr-uni-bochum.de*