German Aerospace Center (DLR) answers a question of cosmic proportions: How much power does sunlight hold?

Embedded PC controls exact sun tracking for Diskus solar concentrator

The Institute of Solar Research at the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt - DLR) in Cologne-Porz is engaged in the development and qualification of concentrating solar systems that generate electricity, heat and fuels. A parabolic mirror with a diameter of 1.5 m can concentrate the sun's rays so precisely and to such intensity that on one point, 1 and 5 cent coins melted in a DLR experiment. This is caused by a 10,000-fold concentration of the sunlight, with which astounding temperatures of over 3000 °C can be created with this system.

Concentrating solar systems work on a large scale like burning glasses on a small scale: they bundle solar radiation and produce heat. Solar thermal energy can be used for generating electricity, for direct application in technical processes or for the production of fuels. In the context of research into point and linear-focusing solar heat, the Diskus solar dish system (Dish mit kurzer Brennweite zur Solarkonzentration - dish with short focal length for solar concentration) was developed at the DLR.

The parabolic mirror tracks the sun in two axes. The highly concentrated, direct solar radiation at the focal point, in the range of 1 KW light power with variable flux density, is thus available for different experiments and measurements. Temperatures of 3000 °C and energy flux densities of 10 MW/m² can be achieved. The prerequisite for the functionality of the Diskus is the constant precise alignment of the mirror to the sun.

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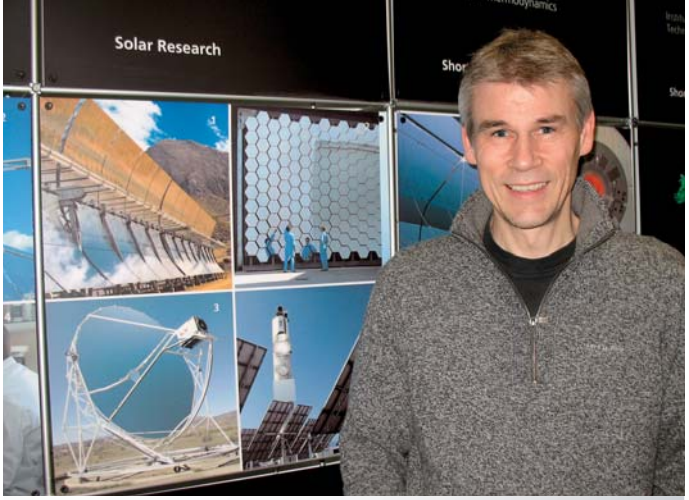

Carsten Spenke, Institute of Solar Research, Deutsches Zentrum für Luft- und Raumfahrt e.V., in the Helmholtz community

The Institute of Solar Research at the DLR emerged from the DLR Institute of Technical Thermodynamics in July 2011 as an independent facility. It is the largest research organization in Germany engaged in the development of concentrating solar systems in order to generate heat, electricity and fuels for a sustainable energy supply for the Earth, with locations in Cologne-Porz, Stuttgart, Almería (Spain) and, since 2011, also in Jülich, Germany.

Software function blocks ensure precise alignment

The heart of the control system is a Beckhoff CX5020 Embedded PC, which handles all control functions. The position of the sun is calculated by means of the software function block FB_SPA in the TwinCAT "Solar Position Algorithm" library and is transferred to TwinCAT NC PTP for the control of the two stepper motors. With a motor current of up to 5 A, the EL7041 stepper motor terminals for the EtherCAT Terminal system enable sufficiently high dynamics of the selected drive solution. The actual positions of the two axes are fed back by two absolute rotary encoders mounted on the Diskus gearbox output. The encoders are directly connected to an EL5002 SSI interface EtherCAT Terminal. Numerous EtherCAT Terminals are available for the acquisition of measuring data and offer the possibility to evaluate a large number of different signals. The user interface was implemented via a Beckhoff CP6903 Control Panel with touch screen, which is ideally suited for outdoor use thanks to IP 65 protection on the front side.

The tracking accuracy was demonstrated at the "Tag der Luft- und Raumfahrt im DLR, Köln-Porz" (Aerospace Day at the DLR, Cologne-Porz) in September 2011. A container for coins was mounted at the focal point of the Diskus beforehand. Visitors were able to have a hole melted in a coin whenever a break in the cloud cover allowed. The speed with which this happened demonstrated the energy of the sunlight in impressive fashion.

Further Information:

www.dlr.de/sf

www.beckhoff.com/TwinCATSolarPosition