

## Solar Mirror Soiling Measurement

### Refined solar resource assessment with Tracking Cleanliness Sensor ("TraCS")

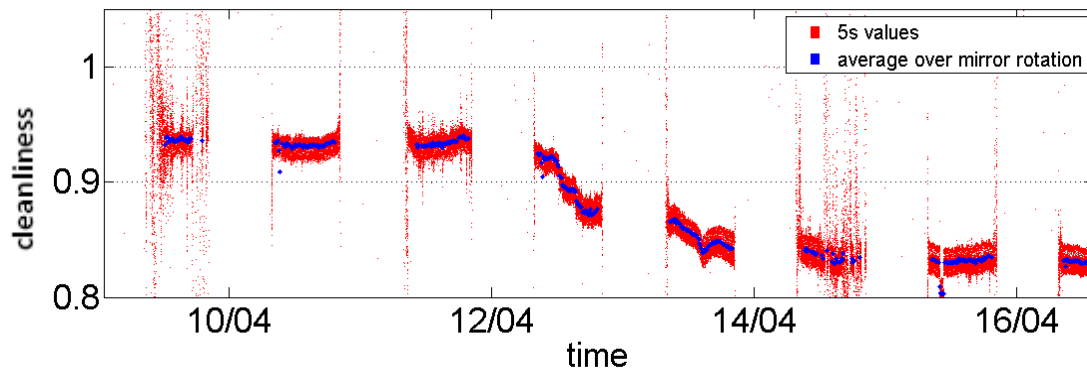
Mirror soiling affects the performance and maintenance of CSP plants, and thus the production cost for electricity. In an operating power plant the cleaning cycles can be optimized with adequate measurement data.

TraCS has been developed by scientists in the DLR Institute of Solar Research. The TraCS device measures the effective reflectance including cleanliness of a sample solar mirror continuously. The measurement principle is a comparison between measured beam irradiance (DNI) and reflected beam irradiance from the sample mirror, both measured with a standard pyr heliometer. A geared motor rotates the mirror in its plane to get average soiling values over the mirror surface which makes TraCS even more accurate than standard reflectometers. The soiling evolution is determined with the standard irradiation measurement process.



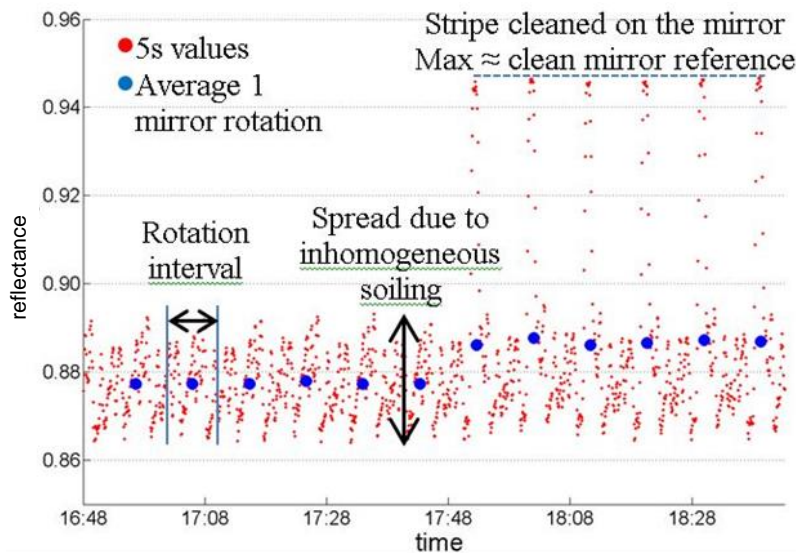
*TraCS instrument installed on Kipp & Zonen sun tracker Solys 2*

The diagram below shows the TraCS signal over a specific one-week measurement period. The cleanliness reduces by about 10 % as consequence of a dust event of two days.



*TraCS measurement during a Saharan dust event in the Tabernas desert, Spain*

To average over the soiled spots, the test mirror is actively rotated by a geared motor. TraCS has been validated successfully by DLR. The limits for the best measurement conditions have been determined with tests at different sites. As a further valuable feature, soiling of the (main) pyrheliometer can be identified and eventually corrected with TraCS, thus enhancing the DNI measurement accuracy.



**TraCS measurement curve with mirror rotations, and partial cleaning at 17:50h**

The instrument is available from CSP Services as a standard add-on to the Kipp & Zonen Solys2 tracker system.



**TraCS setup with pyrheliometer, mirror and drive**

**References:**

Patent DE 10 2012 215 153: Verfahren und Messsystem zur Verschmutzungsmessung an einem Solarspiegel

F. Wolfertstetter et al.: A novel method for automatic real-time monitoring of mirror soiling rates, SolarPACES Conference, 11-14 Sept. 2012, Marrakech, Morocco, Desertec Best Paper Award 2012

F. Wolfertstetter et al.: Monitoring of mirror and sensor soiling with TraCS for improved quality of ground based irradiance measurement, Energy Procedia 49(0): 2422-2432, 2014

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