

- Introduction
- Stellio Heliostat & Hami Project
 - Features of the Stellio heliostats
 - DNA of the heliostat and how it is determined
- Heliostat field digital twin
 - Realization
 - Utilization
- Summary





MOBILITY



ENERGY





Main characteristics:

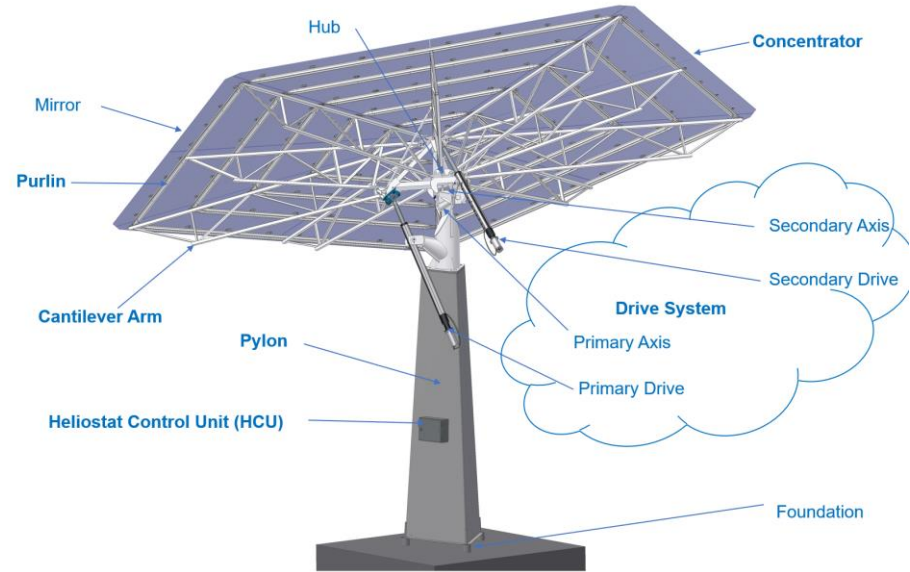
- Novel kinematics with inclined axes (slope drive)
- Two linear actuators
- Reflector structure with high stiffness
- High optical quality
- Precise tracking, sophisticated controls

Prototypes & pre-series 2014, 2017

50 MW Hami plant: first commercial application

Awards from SolarPACES, CSP Today, CSP Plaza

<https://www.stellio.solar>







Power Plant

Digital Twin



Assembly

DNA



Field Erection

DNA



Calibration

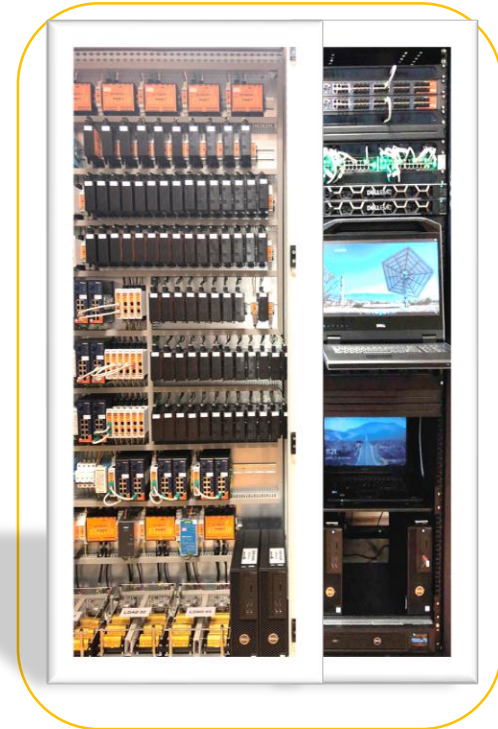
DNA



O&M

Improvements

Maintenance




Heliostat assembly – Data management

Installation & Test:

100 % test of linear drives
before installation

Service host enable





247 / 192.168.108.106 : 502

STOP COM

	PRIMARY	SECONDARY
S.N.	HM03018395HB-A	HM03028302HB-A
TYPE	HONGBA2	HONGBA2

START TEST

51:32

LOC S.N
1810247983

INITIALIZATION / UPDATING FIRMW.

Ver. firmw. / from 138 to 192 Pages / 3028 from 3028

FIRST SEEK MARK

CHECK PRIMARY LIMIT SWITCH

CHECK SECONDARY LIMIT SWITCH

LAST SEEK MARK

SEND TO SECURITY POSITION

TEST OK

Characterization:

Kinematics of each hel. is precisely measured

3D CHARACTERIZATION V16.4.40

START TEST STOP

CNC N° PRELIMINARY CNC N°

CONNECTED TEST OK TEST FAIL TEST ERROR TEST STOP TEST START TEST STOP TEST START TEST STOP

WAIT

FEMORY RECEIVED SENT

SECONDARY RECEIVED SENT

RECEIVED RECEIVED SENT

Deflectometry:

Reflector surfaces are surveyed
and slope errors determined

S3 DEFLECTOMETRY VER. 4.0.0

192.168.138.101 STOP

START TEST 3:30

LOC IN.
PRIMARY S.N. H8823297HB-A
HILICOST S.N. 7809

AZIMUTH 180
ELEVATION 45 SET

PRIMARY
Max. PCK 226.66 mm

SECONDARY
Max. PCK 248.14 mm

LOC FIELD POSITION X: 0.07 Y: 0.07 PRINT BMP FILE

ID 1527
COM NAME A39-1A-09
IP ADDRESS 172.31.0.1.058
SLAVE S COM
OKS CIRCUITRYC007
PASS 33

VALIDATE TEST

Heliostat Assembly Database

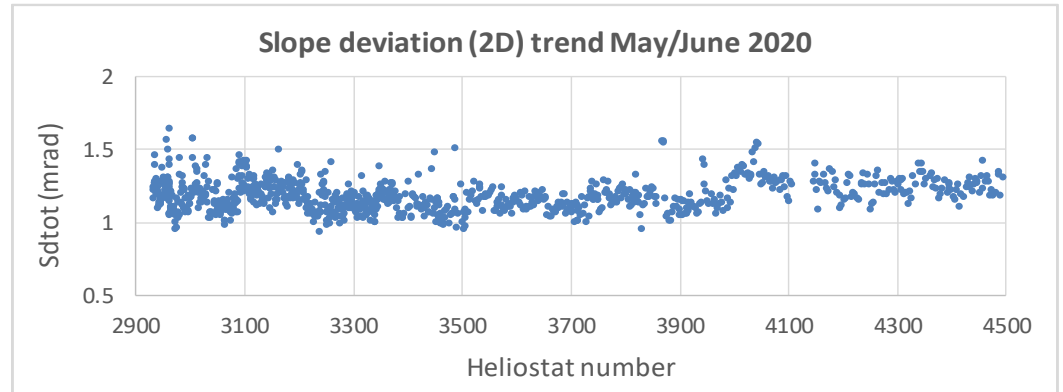
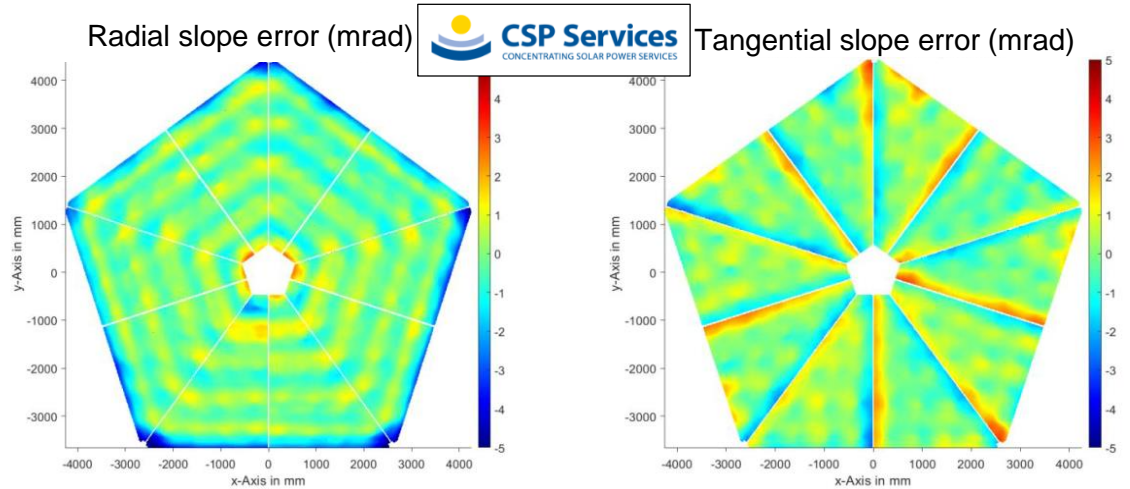
loc_SN	drive_pr_SN	drive_sec_SN	hel_SN	field_pos	m01_stow	m02_stow	m03	m04	m05	m06	m07	m08	m09	m10	m11	m12	m13	m14
15051131439	HM03010052HB	HM03020030HB	2	12-101	613,278	582,688	-549,908	-449,975	-724,79	137,839	681,915	251,399	228,756	617,695	69,924	0,013	0,107	-0,001
18032240015	HM03010066HB	HM03020069HB	3	12-100	614,185	582,759	-550,116	-449,677	-723,943	139,397	681,451	251,077	228,457	617,689	69,966	0,035	-0,084	0,048
18032240023	HM03010069HB	HM03020025HB	4	12-099	613,246	583,272	-550,16	-448,301	-723,203	140,027	681,15	250,849	227,526	617,497	69,958	0,086	0,042	0,124
18032240024	HM03010050HB	HM03020028HB	6	12-090	614,024	583,833	-550,248	-449,86	-724,897	138,801	681,45	251,053	227,447	618,08	69,964	0,02	-0,001	0,029
18032240034	HM03010002HB	HM03020068HB	7	13-088	612,277	583,427	-551,114	-448,884	-723,322	138,675	681,532	251,306	227,78	618,044	69,933	0,005	-0,085	0,046



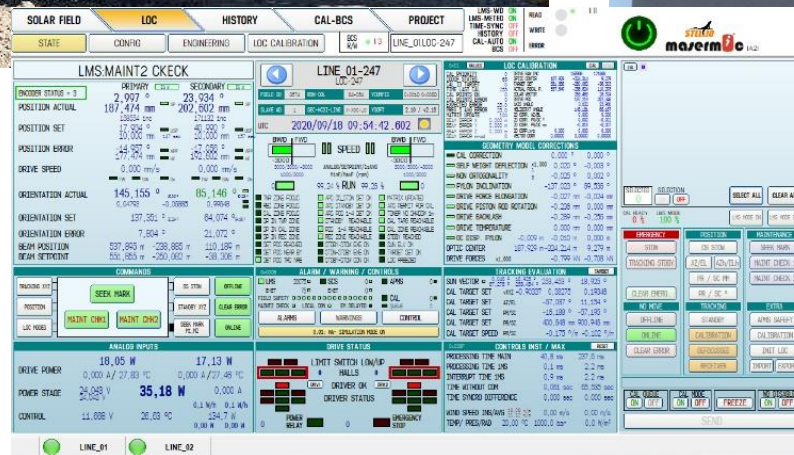


Heliostat optical quality

- High optical quality through principle of high precision mirror jig + glue connection to steel structure fully confirmed
- Slope errors of 1.2-1.3 mrad (2D), best heliostats 1.0 mrad





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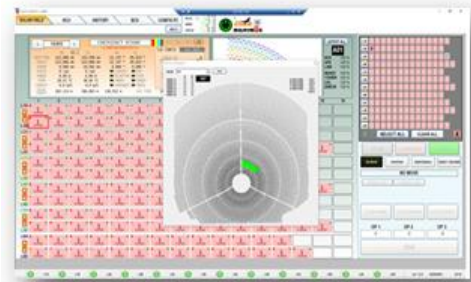
Heliostat commissioning and calibration



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masermⁱ**c**



- Commissioning procedures were tested with digital twin first before execution in real plant
- No trips of Stellio software and control engineers were required for commissioning
- Firmware updates of heliostat controllers are always tested with digital twin
 - Cleaning position and automatization
 - Consideration of reflections from classical horizontal stow on calibration target → slightly modified stow position



- A Stellio field with 14,500 heliostat field has been built and characterized at Hami
- Individually measured Heliostat 'DNA' is used for operation and in the digital twin
- The digital twin is located in Europe at the control system supplier's headquarters.
- It's being used to test commissioning steps and check software changes and improvements before deploying them in the real heliostat field
- The digital twin helped to speed up commissioning and avoid travels





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