

Combining Lasertracker and Laserscanner, various examples

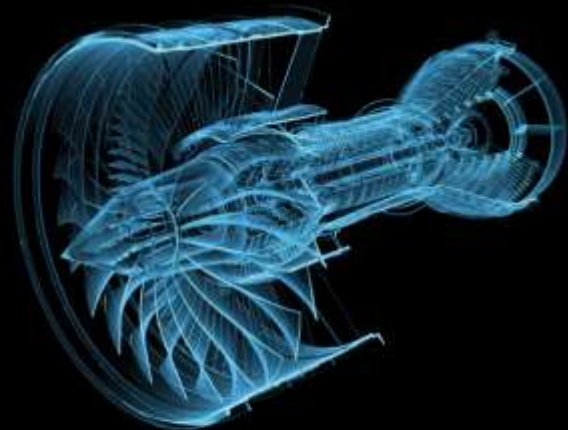
GEOS 3D
UNSERE DEVISE : PRÄZISE

DI Andreas Wurm

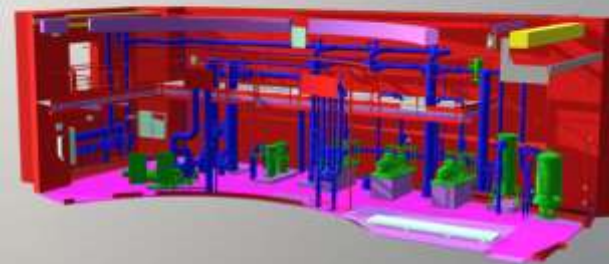
INDUSTRIE- VERMESSUNG



INGENIEUR- VERMESSUNG



3D LASER SCANNING



VISUALISIERUNG

INDUSTRIES



INDUSTRIES



Trackers & Scanner



+



Surphaser Laserscanner



Specs:

- Terrestrial Laserscanner
- Accuracy < 1 mm
- Range > 100 Meters
- Up to 1 Million Points per second

Surphaser Laserscanner



Different configurations:

USR: 0.25m – 7m

IR: 1m – 35m

LR: 1m – 110m

USR: 0.25m – 7m



Configuration	75HSX HQ 208K pps Class 3R	80HSX HQ 208K pps Class 1	80HSX HP 832 Kpps Class 1
Recommended Work Range (m)	0.25–2.5	0.25–7	0.25–7
Ambiguity Range (m)	90	180	180
Angular Uncertainty ^{1,3} , arc sec	25	25	25
Range Noise ^{1,2} , mm, 90% reflectivity	0.025@ 0.3–2m	0.045@ 0.3–4m	0.11@ 0.3–4m
Range Noise ^{1,2} , mm, 10% reflectivity	0.07@ 0.5m–1.8m	0.14@ 0.3–4m	0.3@ 0.3–4m
Range Uncertainty ³ , mm	<0.15@ 1.5m	<0.25@ 1.5m	<0.25@ 1.5m

USR: 0.25m – 7m



Configuration	75HSX HQ 208K pps Class 3R	80HSX HQ 208K pps Class 1	80HSX HP 832 Kpps Class 1
Recommended Work Range (m)	0.25–2.5	0.25–7	0.25–7
Ambiguity Range (m)	90	180	180
Angular Uncertainty ^{1,3} , arc sec	25	25	25
Range Noise ^{1,2} , mm, 90% reflectivity	0.025@ 0.3–2m	0.045@ 0.3–4m	0.11@ 0.3–4m
Range Noise ^{1,2} , mm, 10% reflectivity	0.07@ 0.5m–1.8m	0.14@ 0.3–4m	0.3@ 0.3–4m
Range Uncertainty ³ , mm	<0.15@ 1.5m	<0.25@ 1.5m	<0.25@ 1.5m

IR: 1m – 35m



Configuration	SR_100	IR_100HQ ⁴	IR_100HS ⁴
Recommended Work Range (m)	1-7	1-35	1-50
Ambiguity Range (m)	90	90	90
Angular Uncertainty ^{1,3} , arc sec	15	15	15
Range Noise ^{1,2} , mm, 90% reflectivity	0.024@4m	0.07@10m	0.16@10m
Range Noise ^{1,2} , mm, 10% reflectivity	0.088@4m	0.41@10m	0.3@10m
Range Uncertainty ³ , mm	<0.3@3m	<0.35@5m	<0.7@15m

IR: 1m – 35m



Configuration	SR_100	IR_100HQ ⁴	IR_100HS ⁴
Recommended Work Range (m)	1-7	1-35	1-50
Ambiguity Range (m)	90	90	90
Angular Uncertainty ^{1,3} , arc sec	15	15	15
Range Noise ^{1,2} , mm, 90% reflectivity	0.024@4m	0.07@10m	0.16@10m
Range Noise ^{1,2} , mm, 10% reflectivity	0.088@4m	0.41@10m	0.3@10m
Range Uncertainty ³ , mm	<0.3@3m	<0.35@5m	<0.7@15m

LR: 1m – 110m



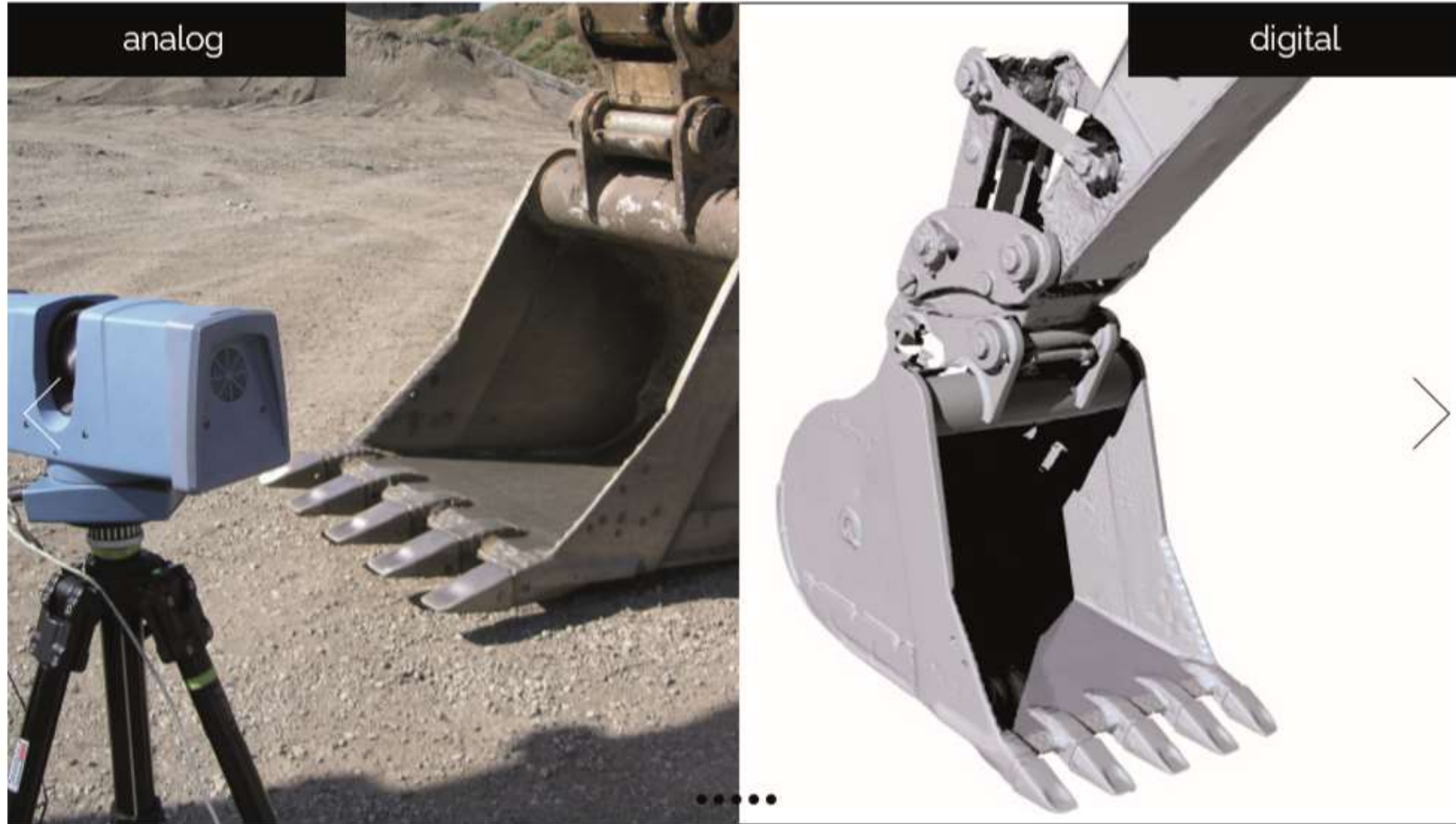
Configuration	10HQ ⁴ 208,000pps	10HS ⁴ 208,000pps	410HQ ⁴ 208,000pps	410HS ⁴ 208,000pps	400HP ⁴ 832,000pps
Recommended Work Range (m)	1-50	1-110	0.4-70	0.4-70	0.4-70
Ambiguity Range (m)	180	180	180	360	180
Angular Uncertainty ¹⁻³ , arc sec.	25	25	25	25	25
Range Noise ^{1,2} , mm, 90% reflectivity	0.12@ 15m	0.25@ 15m	0.06@ 0.4-30m	0.09@ 0.4-30m	0.15@ 0.4m-30
Range Noise ^{1,2} , mm, 10% reflectivity	0.3@ 15m	0.7@ 15m	0.15@ 0.4m-15m	0.15@ 0.4-15m	0.3@ 0.4m-15
Range Uncertainty ³ , mm	<0.7@ 15m	<0.9@ 15m	<0.7@ 15m	<0.9@ 15m	<0.9@ 15m

LR: 1m – 110m

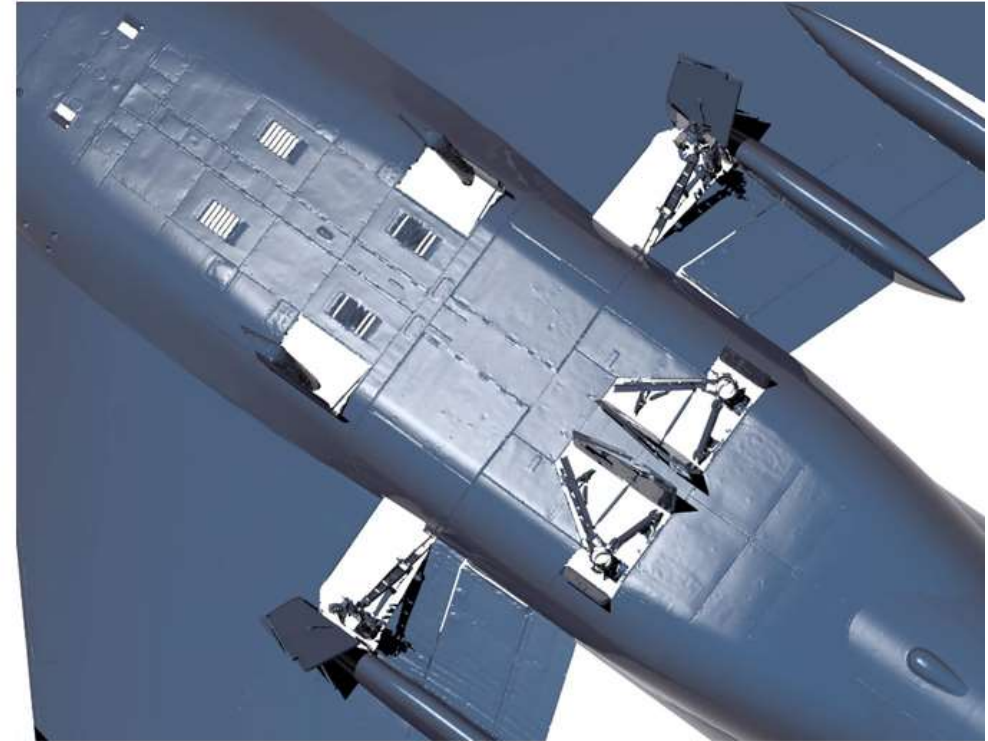


Configuration	10HQ ⁴ 208,000pps	10HS ⁴ 208,000pps	410HQ ⁴ 208,000pps	410HS ⁴ 208,000pps	400HP ⁴ 832,000pps
Recommended Work Range (m)	1-50	1-110	0.4-70	0.4-70	0.4-70
Ambiguity Range (m)	180	180	180	360	180
Angular Uncertainty ¹⁻³ , arc sec.	25	25	25	25	25
Range Noise ^{1,2} , mm, 90% reflectivity	0.12@ 15m	0.25@ 15m	0.06@ 0.4-30m	0.09@ 0.4-30m	0.15@ 0.4m-30
Range Noise ^{1,2} , mm, 10% reflectivity	0.3@ 15m	0.7@ 15m	0.15@ 0.4m-15m	0.15@ 0.4-15m	0.3@ 0.4m-15
Range Uncertainty ³ , mm	<0.7@ 15m	<0.9@ 15m	<0.7@ 15m	<0.9@ 15m	<0.9@ 15m

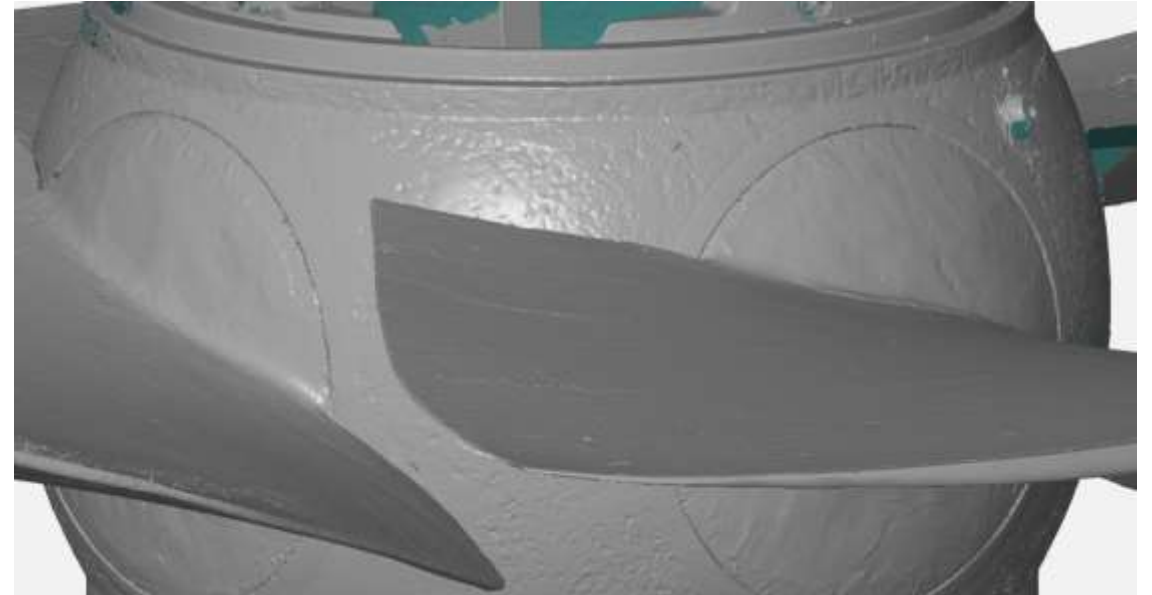
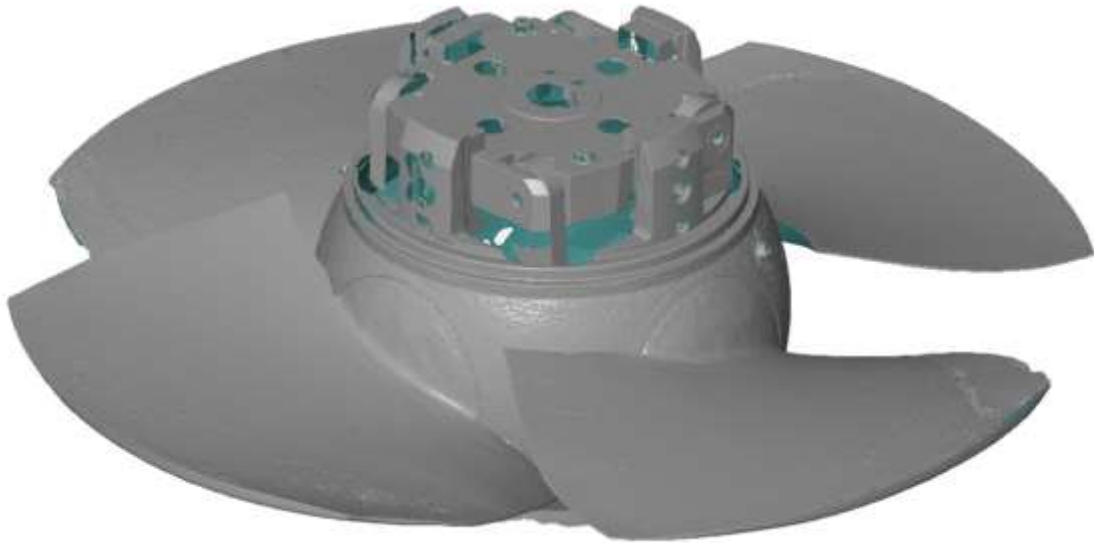
Raw - Data



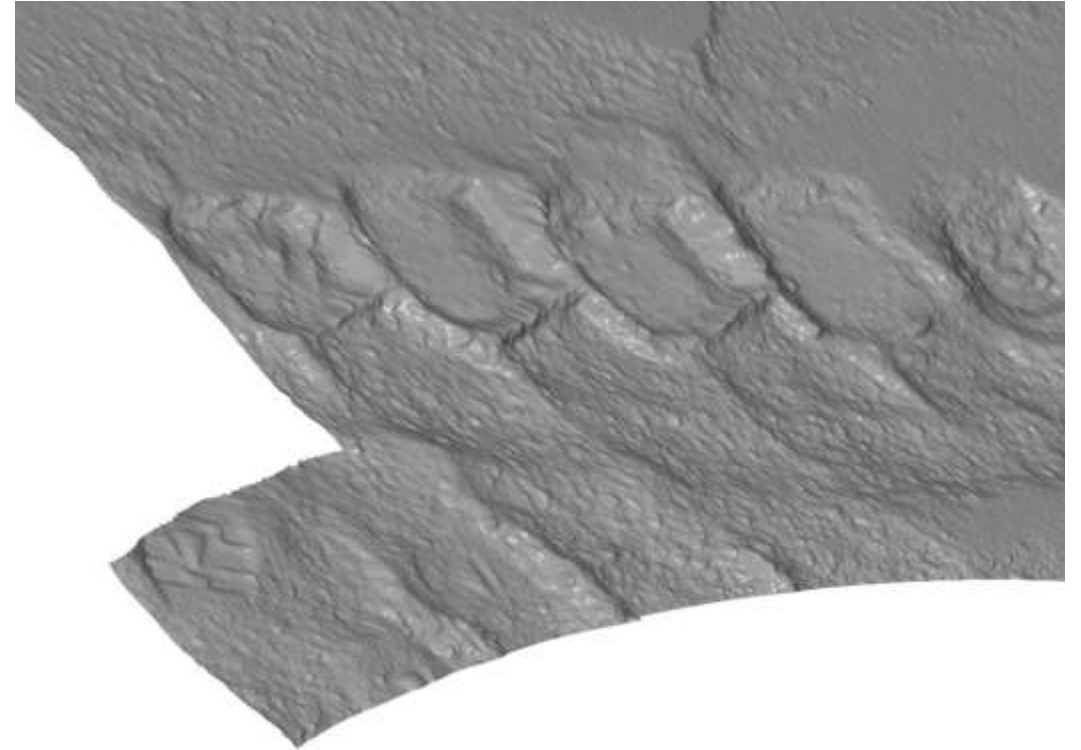
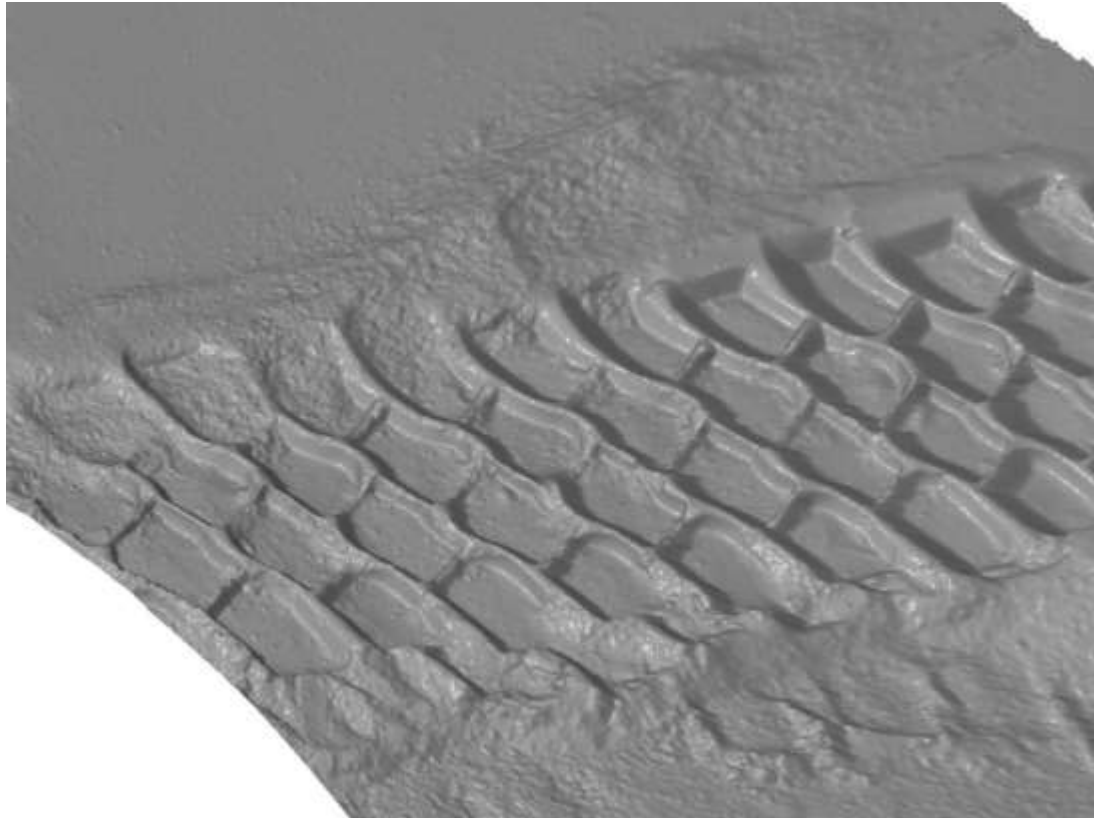
Raw - Data



Raw - Data



Raw - Data

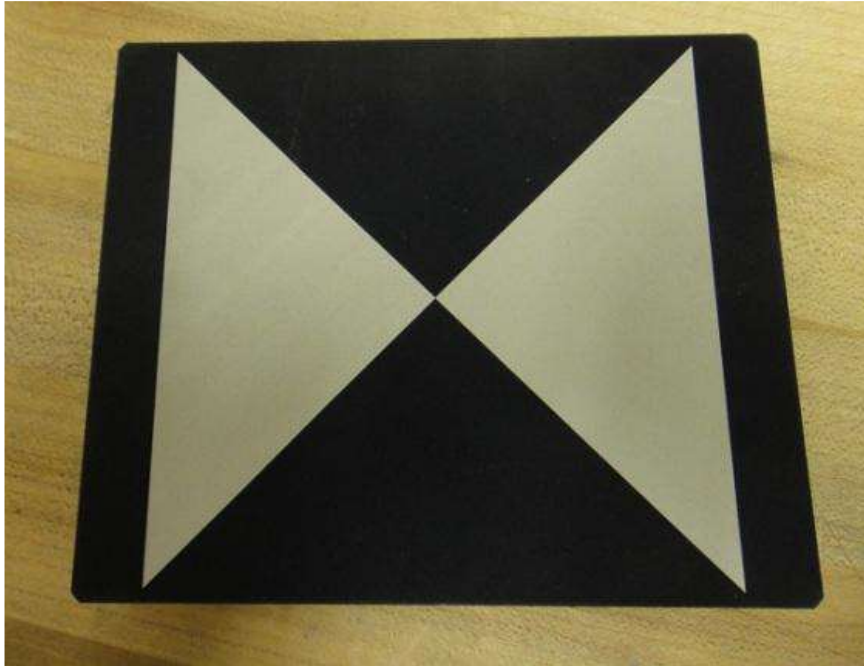


Targets



Spherical, Circular, Rectangular....

Surphaser Targets



Rectangular, 1.5" Half-sphere at the back

Targets



Accuracy : 10m Volume ~ 0,15 mm

Targets



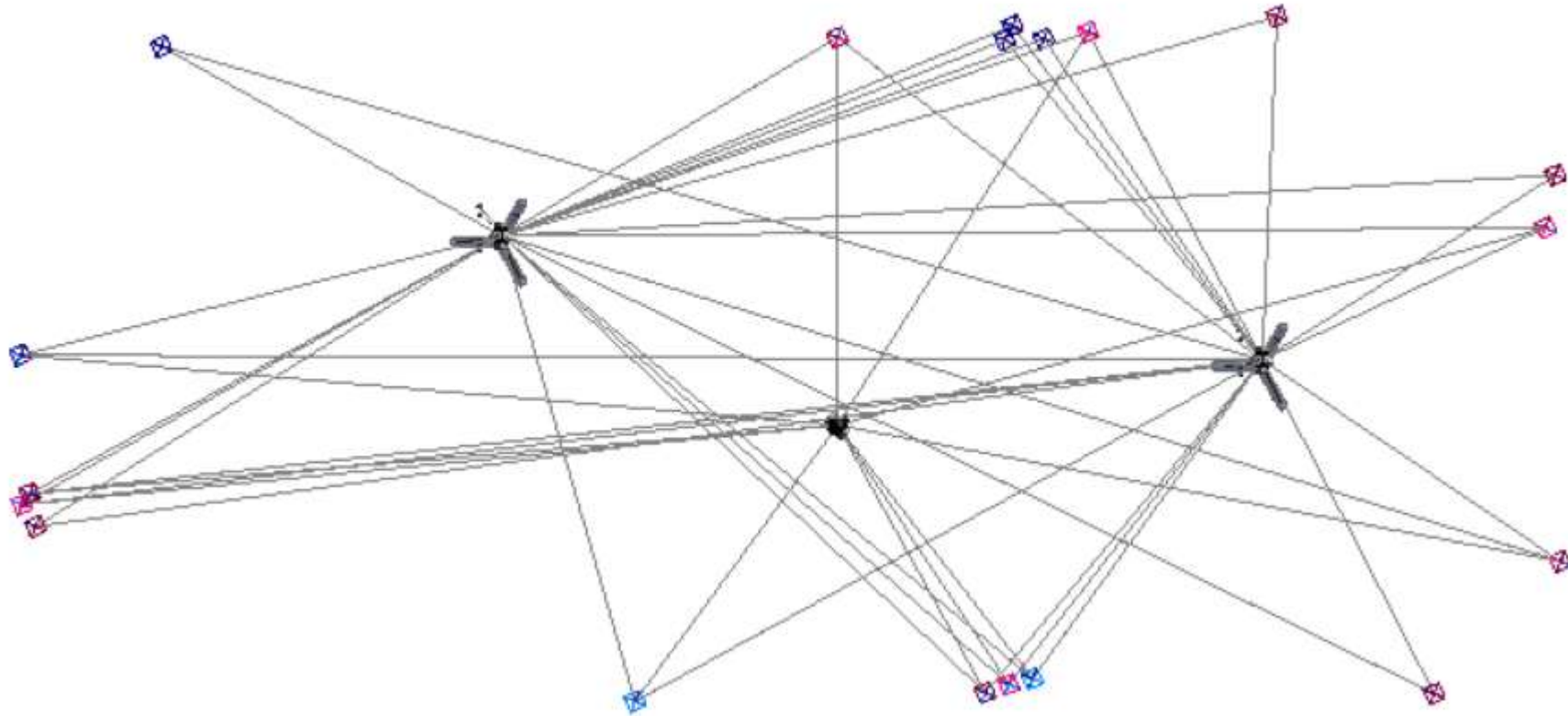
Targets



```
---09:40.53.908---$ Regen Complete  
---09:41.11.903---$ #extInf FindMarkersVV create MFMarkerInfo Sca:  
---09:41.14.684---$ #extInf FindMarkersVV create MFMarkerInfo Sca:  
---09:41.16.980---$ #extInf FindMarkersVV create MFMarkerInfo Sca:  
---09:41.18.978---$ #extInf FindMarkersVV create MFMarkerInfo Sca:  
---09:41.29.475---$ Markers Alignment statistics:  
---09:41.29.475---$ Base Units: mcm  
---09:41.29.475---$ Number of pairs: 4  
---09:41.29.475---$ Minimal displacement: 0.025 mm  
---09:41.29.475---$ Maximal displacement: 0.192 mm  
---09:41.29.475---$ Average displacement: 0.112 mm  
---09:41.29.475---$ Initial Standard deviation: 0.123 mm  
---09:41.29.475---$ Final Standard deviation: 0.081 mm
```

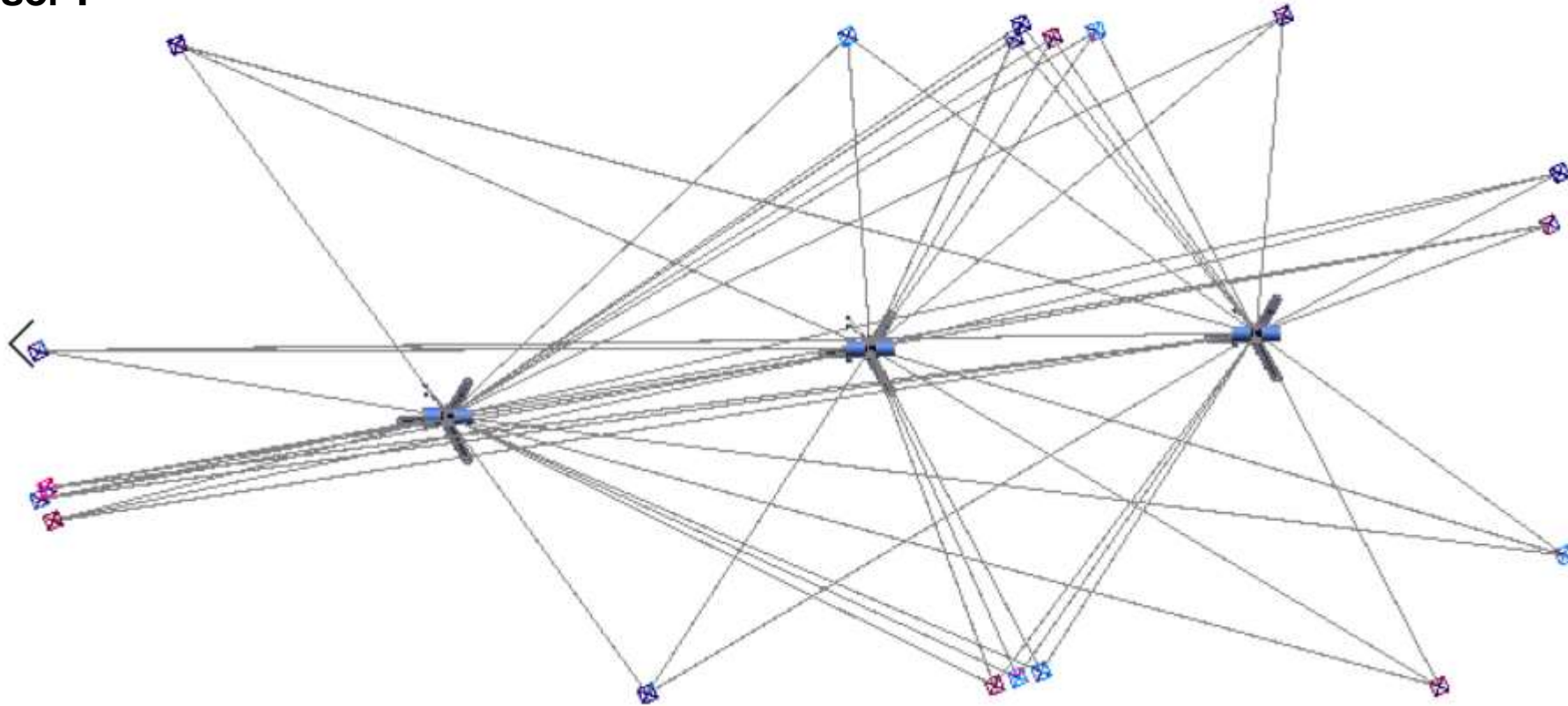
Test Network

3 x AT960 :



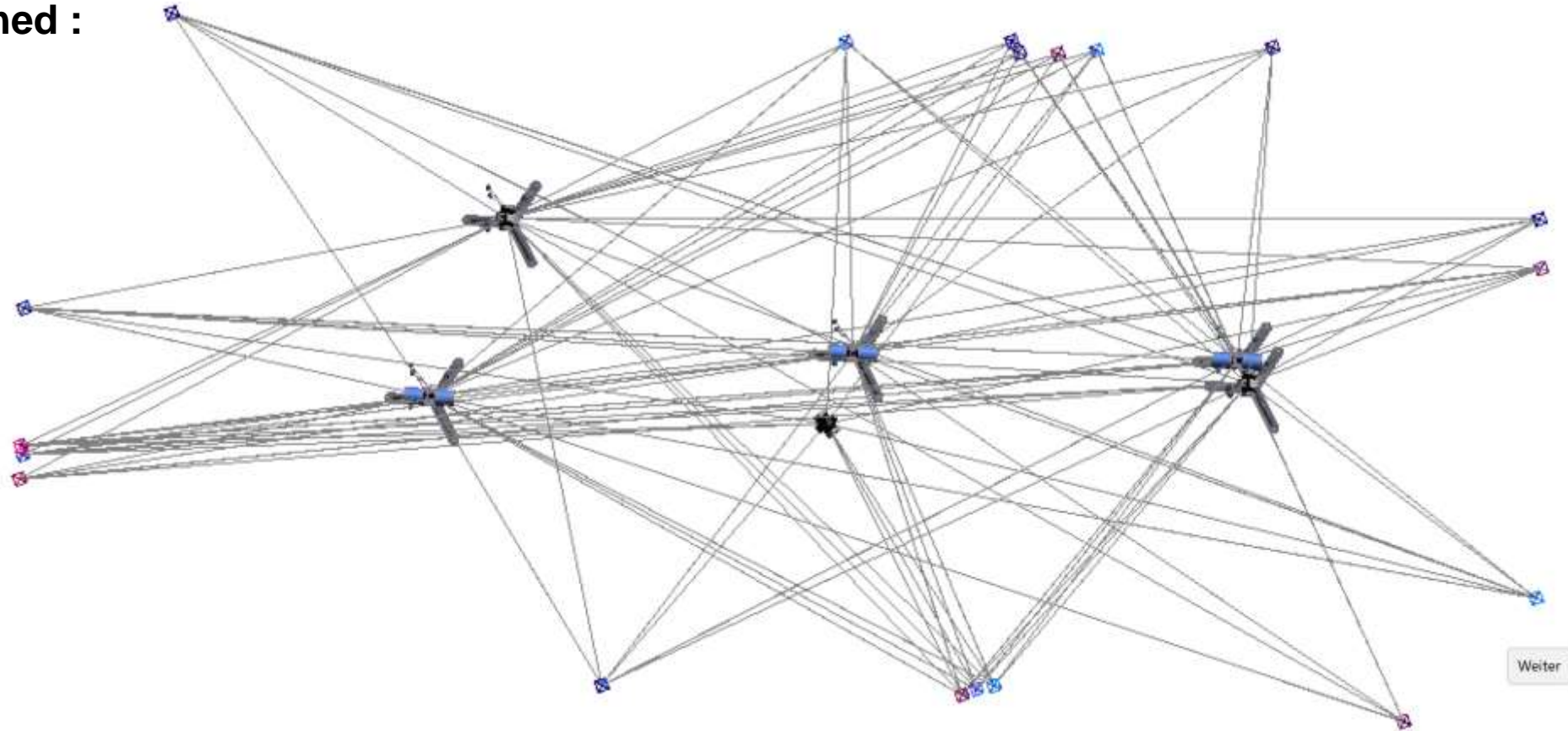
Test Network

3 x Surphaser :



Test Network

Combined :



Test Network

Trackers only:

	Weight	Po...	M...	Ra...	Ux	Uy	Uz	Umag
<input checked="" type="checkbox"/>	1.000	1006	0.12	115%	0.01	0.01	0.01	0.02
<input checked="" type="checkbox"/>	1.000	1016	0.09	68%	0.02	0.02	0.02	0.03
<input checked="" type="checkbox"/>	1.000	1008	0.08	74%	0.01	0.01	0.01	0.02
<input checked="" type="checkbox"/>	1.000	1017	0.08	90%	0.02	0.02	0.02	0.03
<input checked="" type="checkbox"/>	1.000	1007	0.07	66%	0.01	0.01	0.01	0.02
<input checked="" type="checkbox"/>	1.000	1018	0.06	78%	0.01	0.02	0.02	0.02
<input checked="" type="checkbox"/>	1.000	1010	0.05	76%	0.01	0.01	0.01	0.02
<input checked="" type="checkbox"/>	1.000	1011	0.04	43%	0.01	0.01	0.01	0.02
<input checked="" type="checkbox"/>	1.000	1015	0.04	50%	0.01	0.02	0.02	0.03
<input checked="" type="checkbox"/>	1.000	1014	0.04	67%	0.02	0.02	0.02	0.03
<input checked="" type="checkbox"/>	1.000	1012	0.03	48%	0.01	0.01	0.01	0.02
<input checked="" type="checkbox"/>	1.000	1005	0.03	60%	0.01	0.01	0.01	0.02
<input checked="" type="checkbox"/>	1.000	1002	0.03	63%	0.01	0.01	0.01	0.02
<input checked="" type="checkbox"/>	1.000	1000	0.03	73%	0.01	0.01	0.01	0.02
<input checked="" type="checkbox"/>	1.000	1004	0.03	47%	0.01	0.01	0.01	0.02
<input checked="" type="checkbox"/>	1.000	1013	0.03	34%	0.01	0.01	0.01	0.02
<input checked="" type="checkbox"/>	1.000	1009	0.02	57%	0.01	0.01	0.01	0.02
<input checked="" type="checkbox"/>	1.000	1003	0.02	31%	0.01	0.01	0.01	0.02
<input checked="" type="checkbox"/>	1.000	1001	0.02	43%	0.01	0.01	0.01	0.02

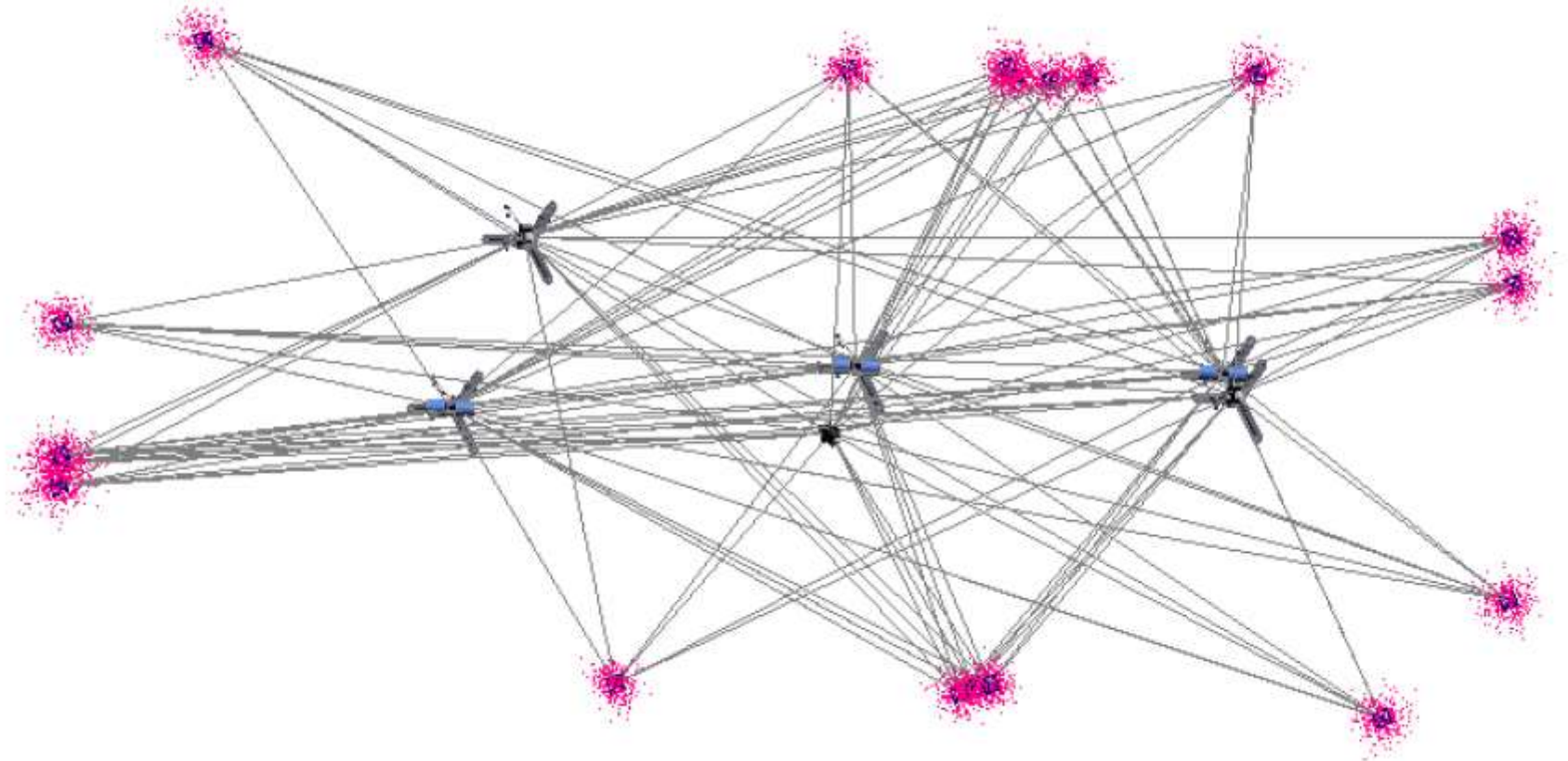
Test Network

Trackers & Surphaser:

	Weight	Po...	Max...	Ra...	Ux	Uy	Uz	Umag
<input checked="" type="checkbox"/>	1.000	1010	0.05	56%	0.06	0.06	0.05	0.10
<input checked="" type="checkbox"/>	1.000	1017	0.16	77%	0.07	0.06	0.07	0.11
<input checked="" type="checkbox"/>	1.000	1003	0.21	65%	0.06	0.05	0.06	0.10
<input checked="" type="checkbox"/>	1.000	1006	0.21	81%	0.06	0.06	0.06	0.10
<input checked="" type="checkbox"/>	1.000	1013	0.21	69%	0.06	0.05	0.06	0.09
<input checked="" type="checkbox"/>	1.000	1005	0.24	83%	0.05	0.05	0.05	0.09
<input checked="" type="checkbox"/>	1.000	1007	0.27	54%	0.06	0.06	0.06	0.11
<input checked="" type="checkbox"/>	1.000	1018	0.32	52%	0.06	0.06	0.06	0.11
<input checked="" type="checkbox"/>	1.000	1008	0.41	84%	0.06	0.06	0.06	0.11
<input checked="" type="checkbox"/>	1.000	1001	0.42	86%	0.05	0.05	0.05	0.09
<input checked="" type="checkbox"/>	1.000	1011	0.49	61%	0.06	0.06	0.06	0.11
<input checked="" type="checkbox"/>	1.000	1015	0.50	51%	0.08	0.06	0.06	0.11
<input checked="" type="checkbox"/>	1.000	1016	0.50	59%	0.07	0.07	0.07	0.12
<input checked="" type="checkbox"/>	1.000	1002	0.51	111%	0.05	0.06	0.06	0.09
<input checked="" type="checkbox"/>	1.000	1000	0.53	56%	0.05	0.05	0.05	0.09
<input checked="" type="checkbox"/>	1.000	1012	0.53	94%	0.05	0.05	0.06	0.09
<input checked="" type="checkbox"/>	1.000	1014	0.55	56%	0.07	0.06	0.06	0.11
<input checked="" type="checkbox"/>	1.000	1004	0.55	109%	0.05	0.06	0.05	0.09
<input checked="" type="checkbox"/>	1.000	1009	0.59	89%	0.05	0.05	0.05	0.09

Test Network

Trackers & Surphaser:



Examples - Cavern



Examples - Cavern



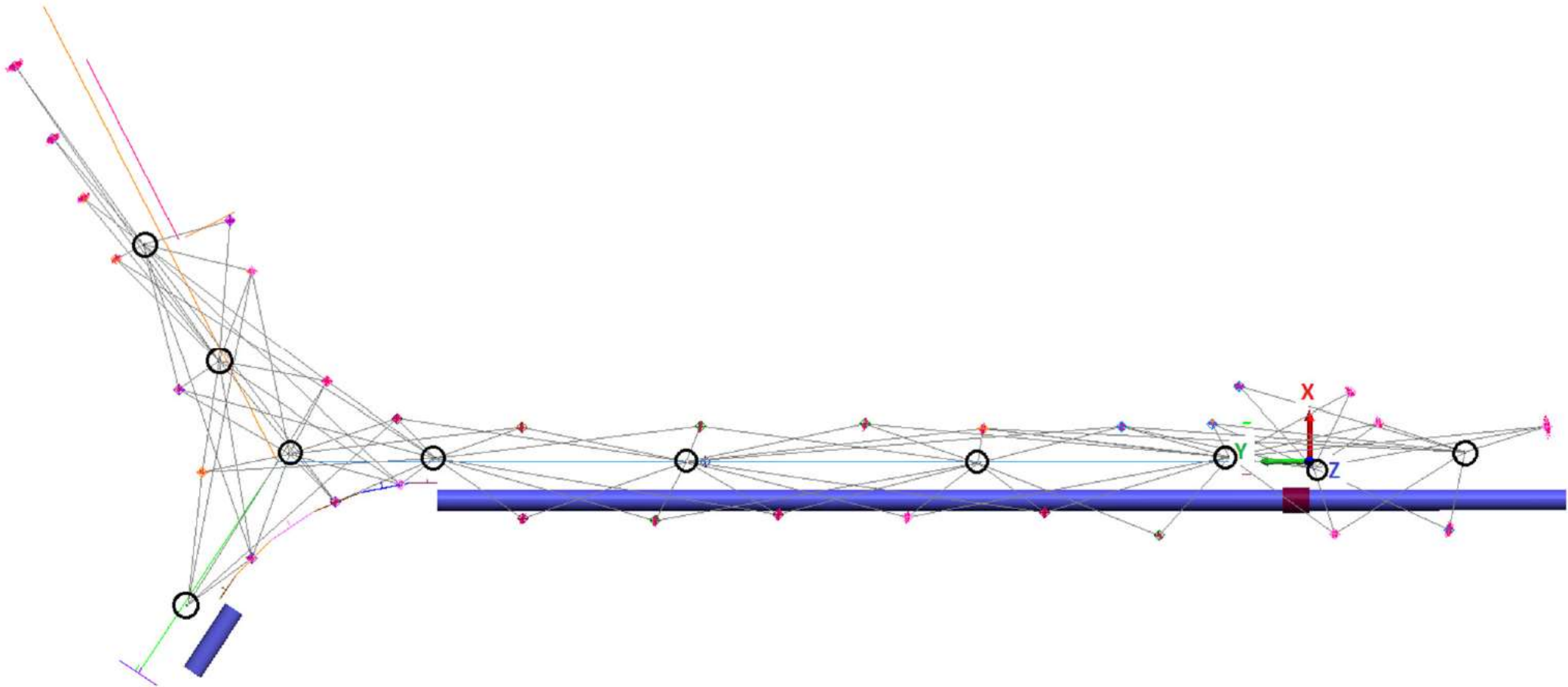
Examples - Cavern



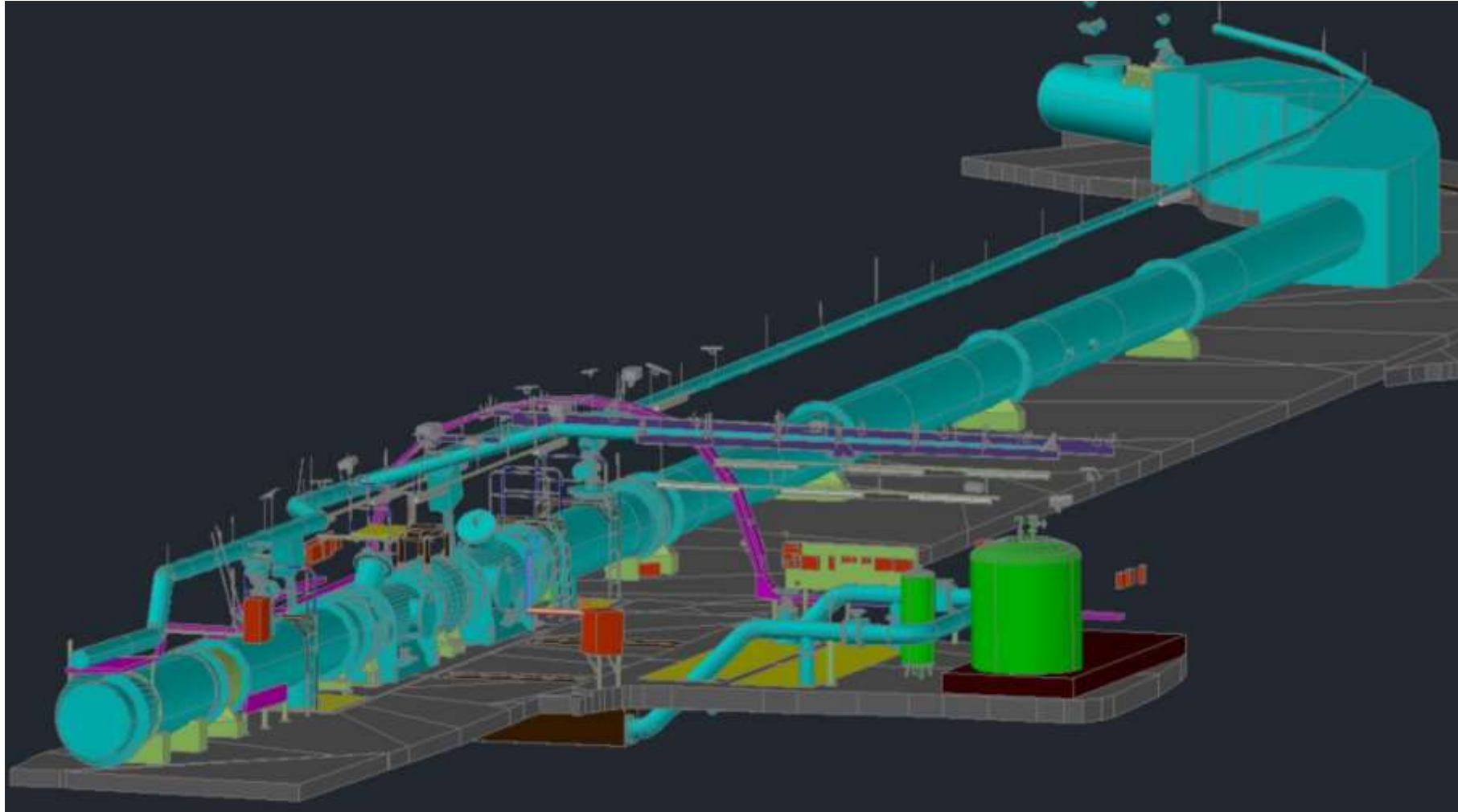
Examples - Cavern



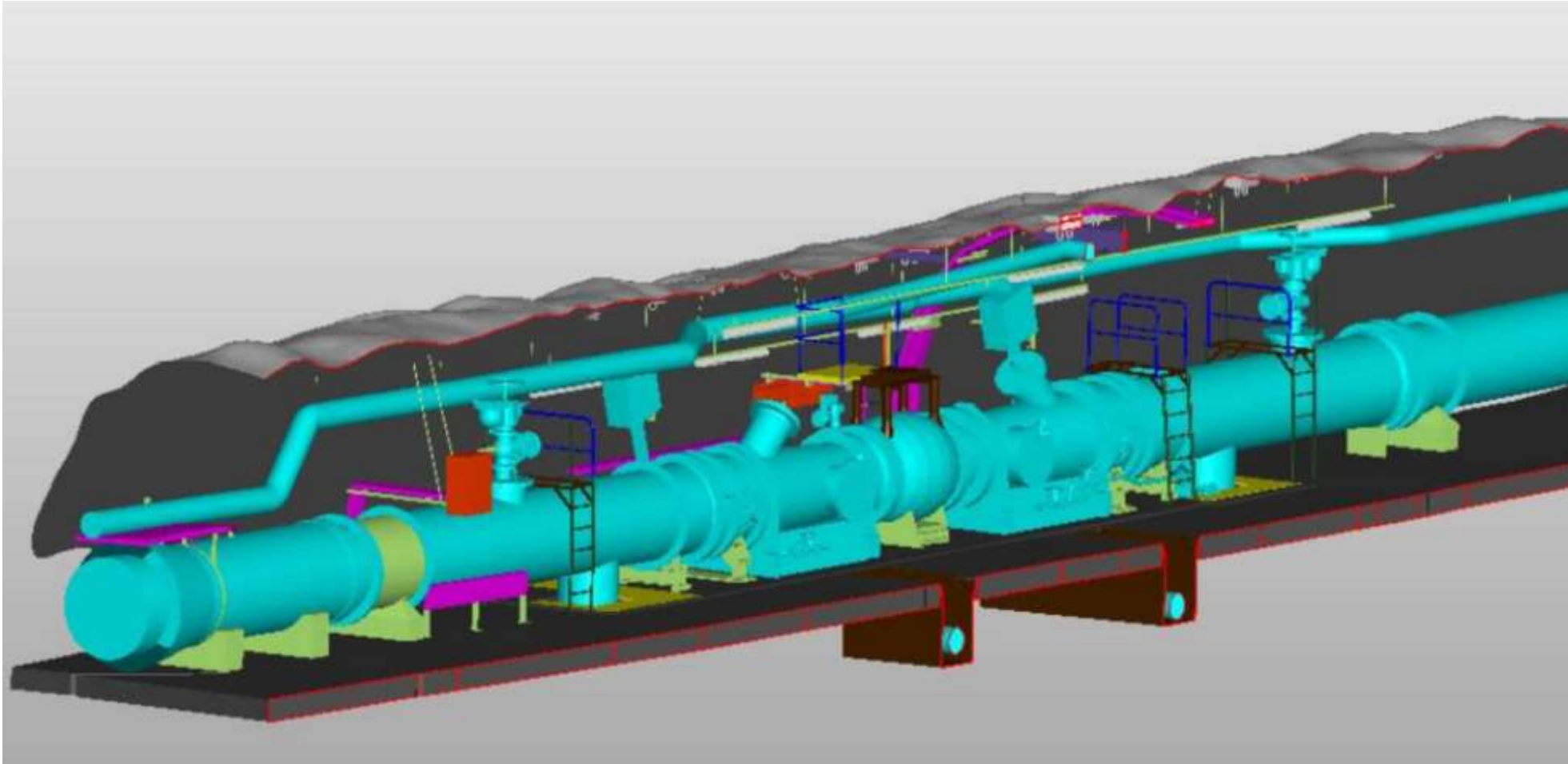
Examples - Cavern



Examples - Cavern



Examples - Cavern



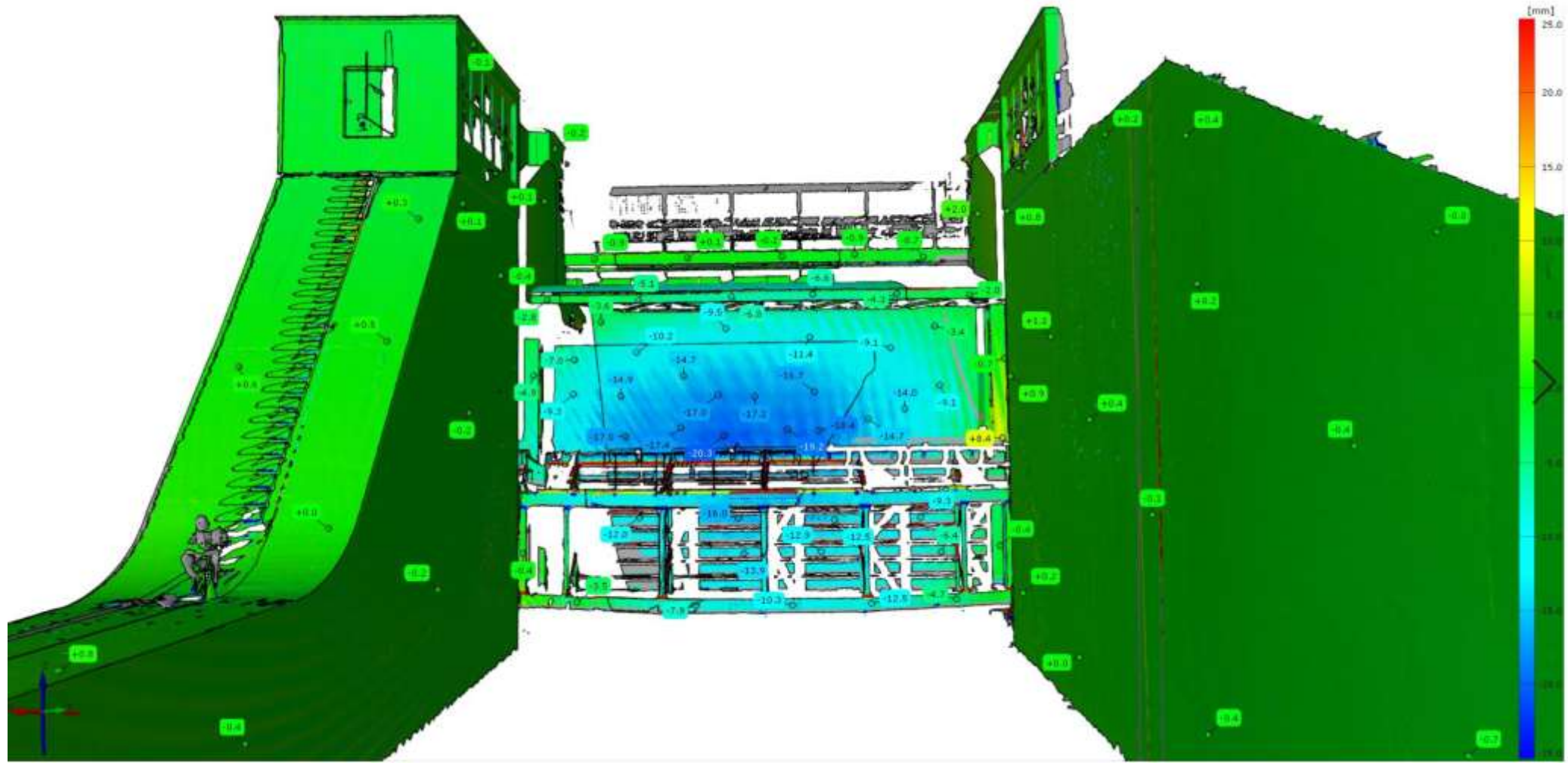
Examples – Power Station



Examples – Power Station



Examples – Power Station

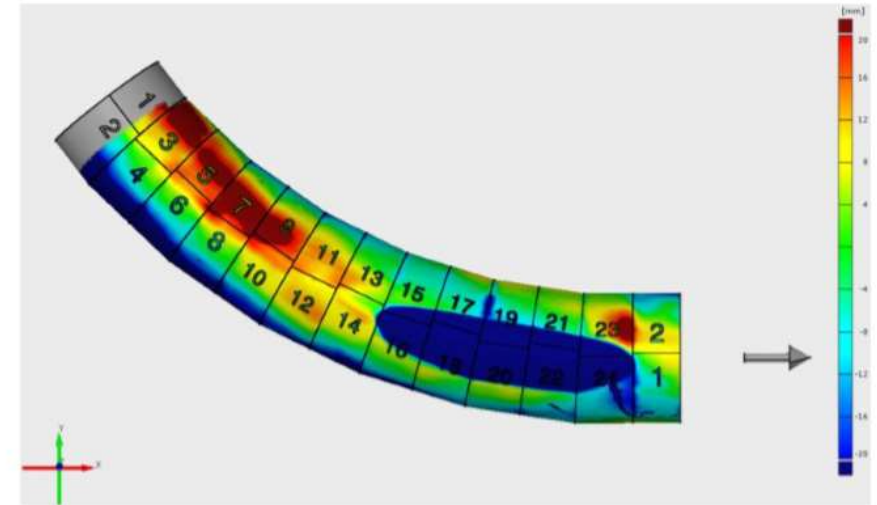
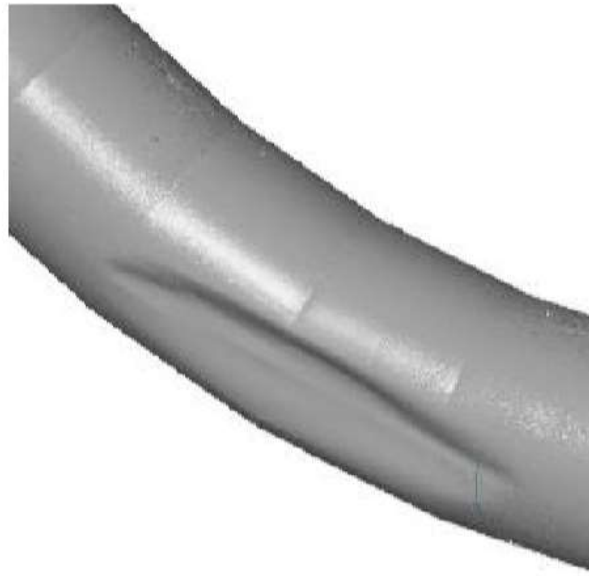


Examples – Power Station

Pipe Scan after fire damage:

3D Laserscan
Deviations &
Reverse Engineering

Benefit:
Evaluation of
geometry and deviations
to nominal geometry

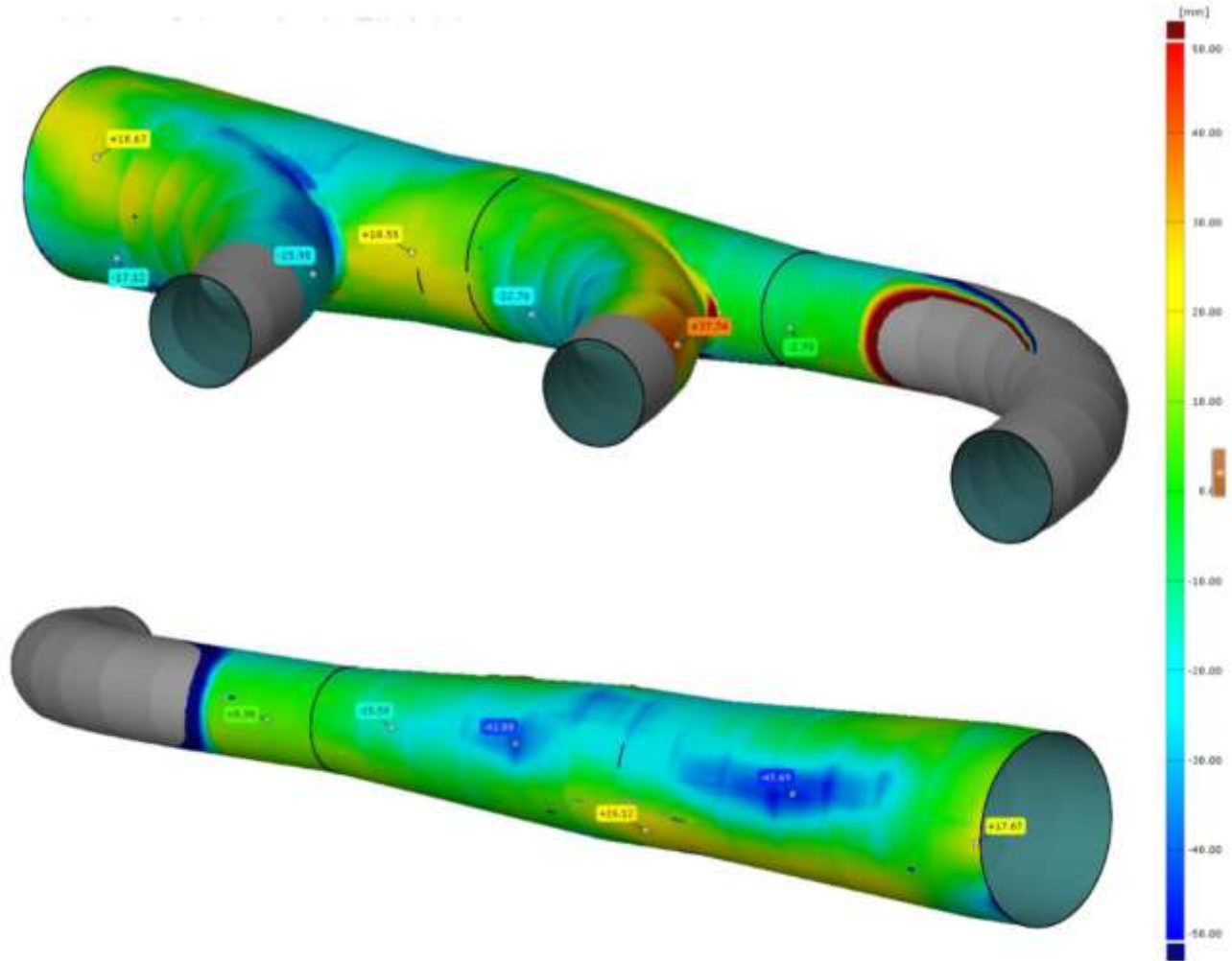


Examples – Power Station

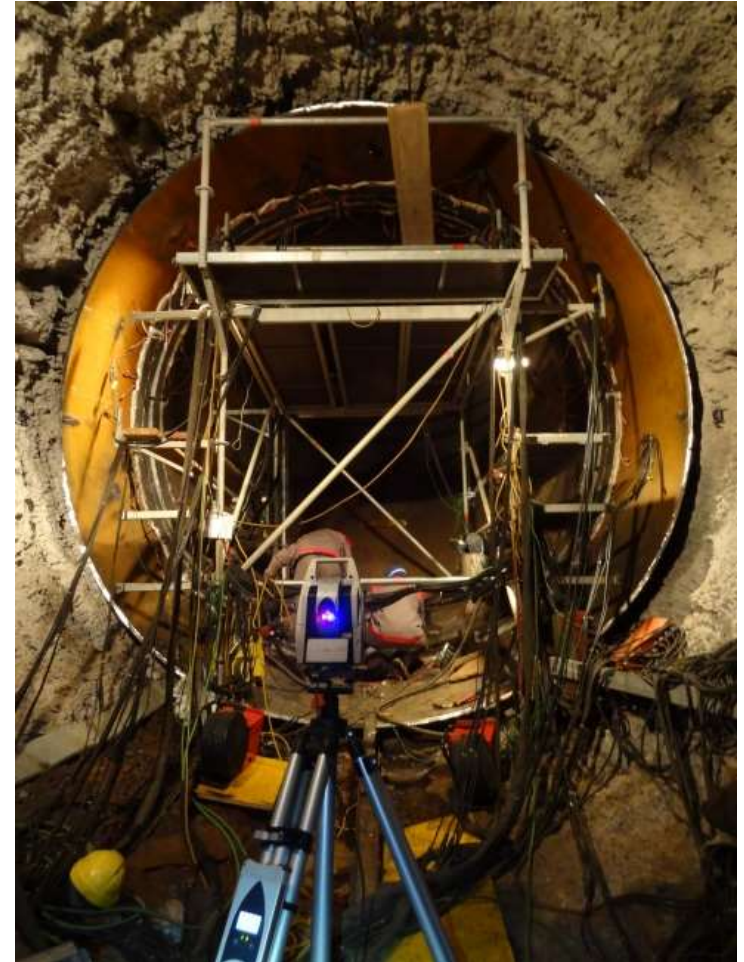
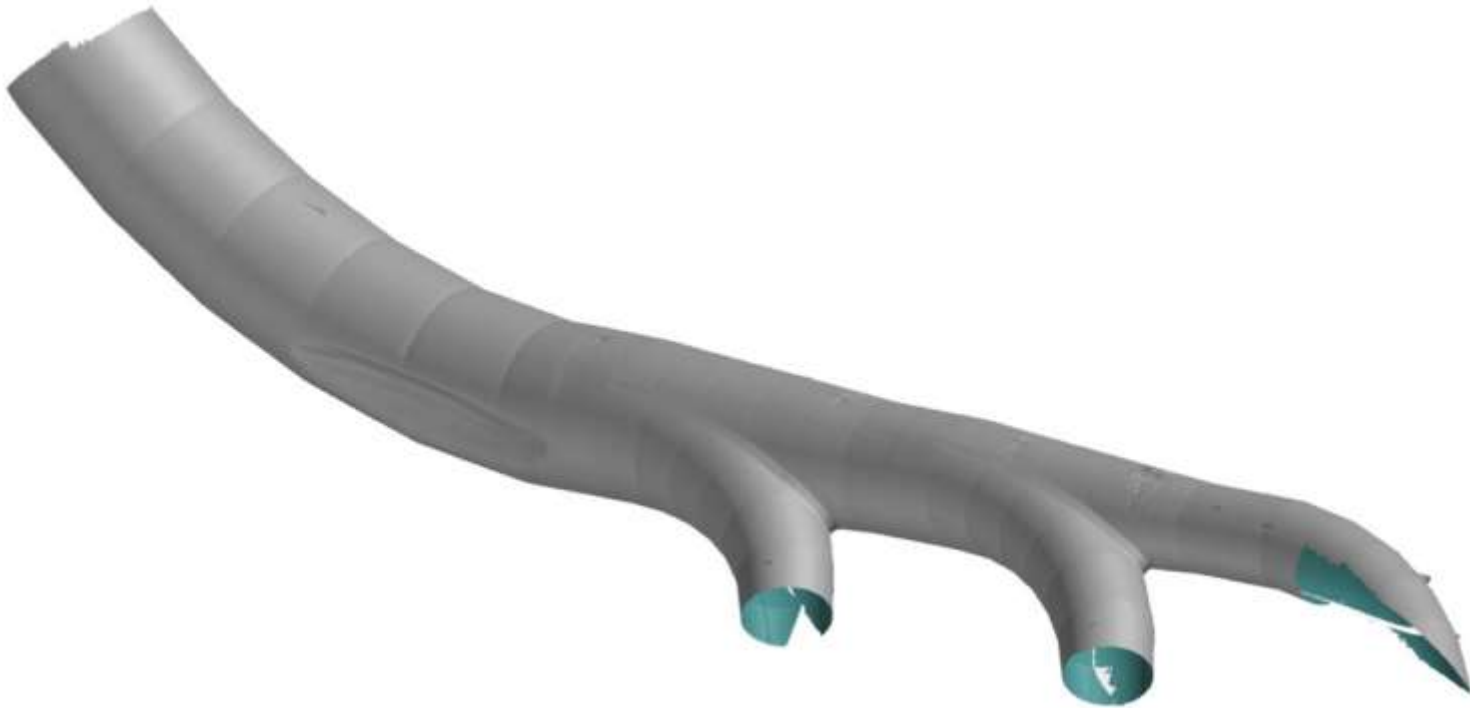
Pipe Scan after fire damage:

3D Laserscan
Deviations &
Reverse Engineering

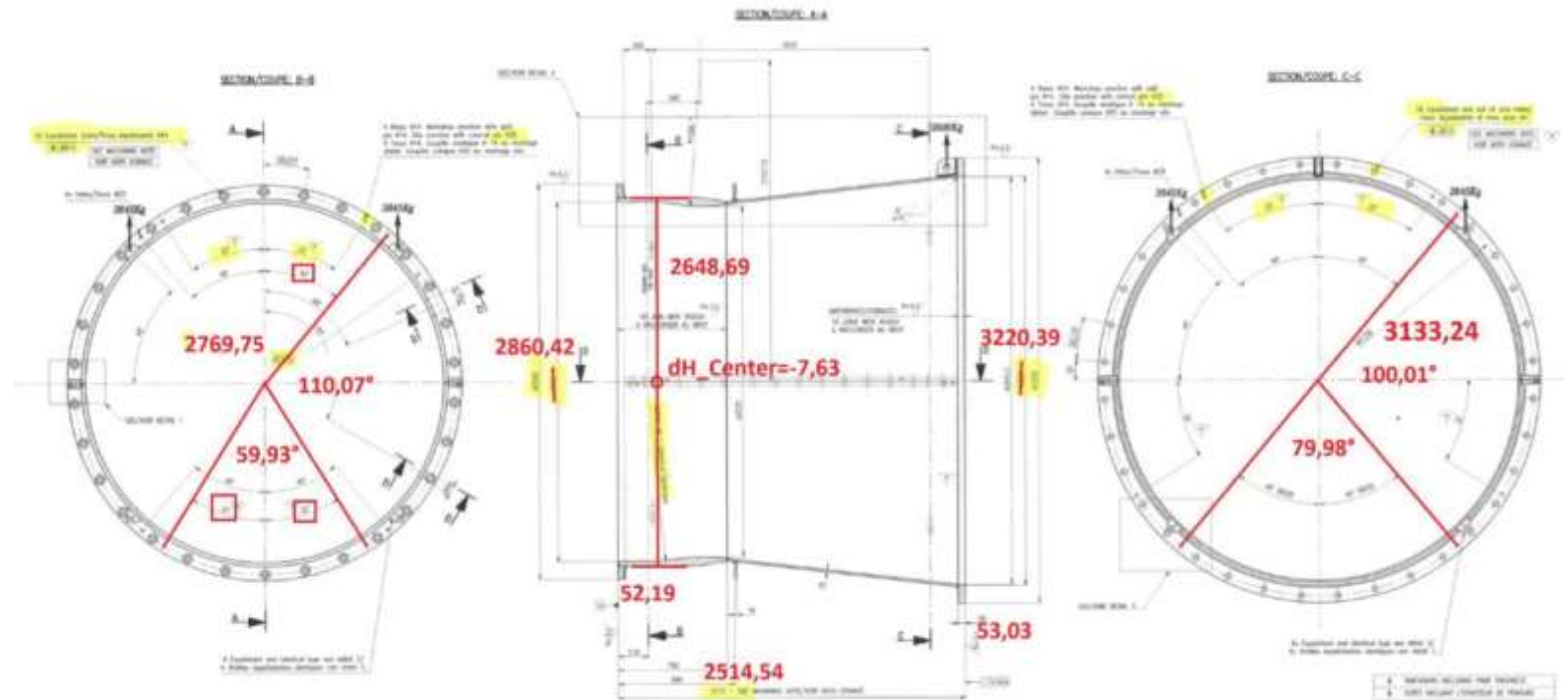
Benefit:
Evaluation of
geometry and deviations
to nominal geometry



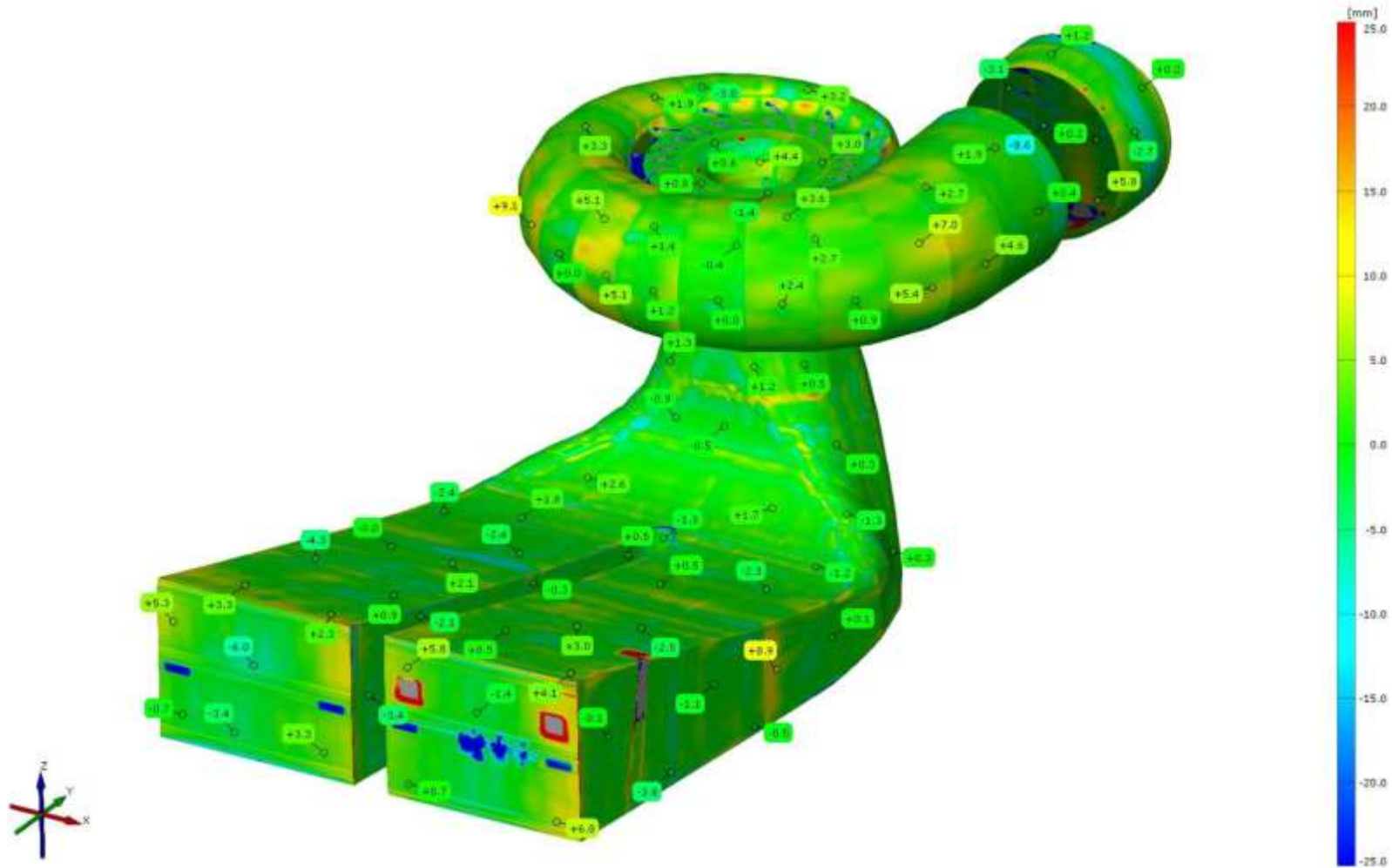
Examples – Power Station



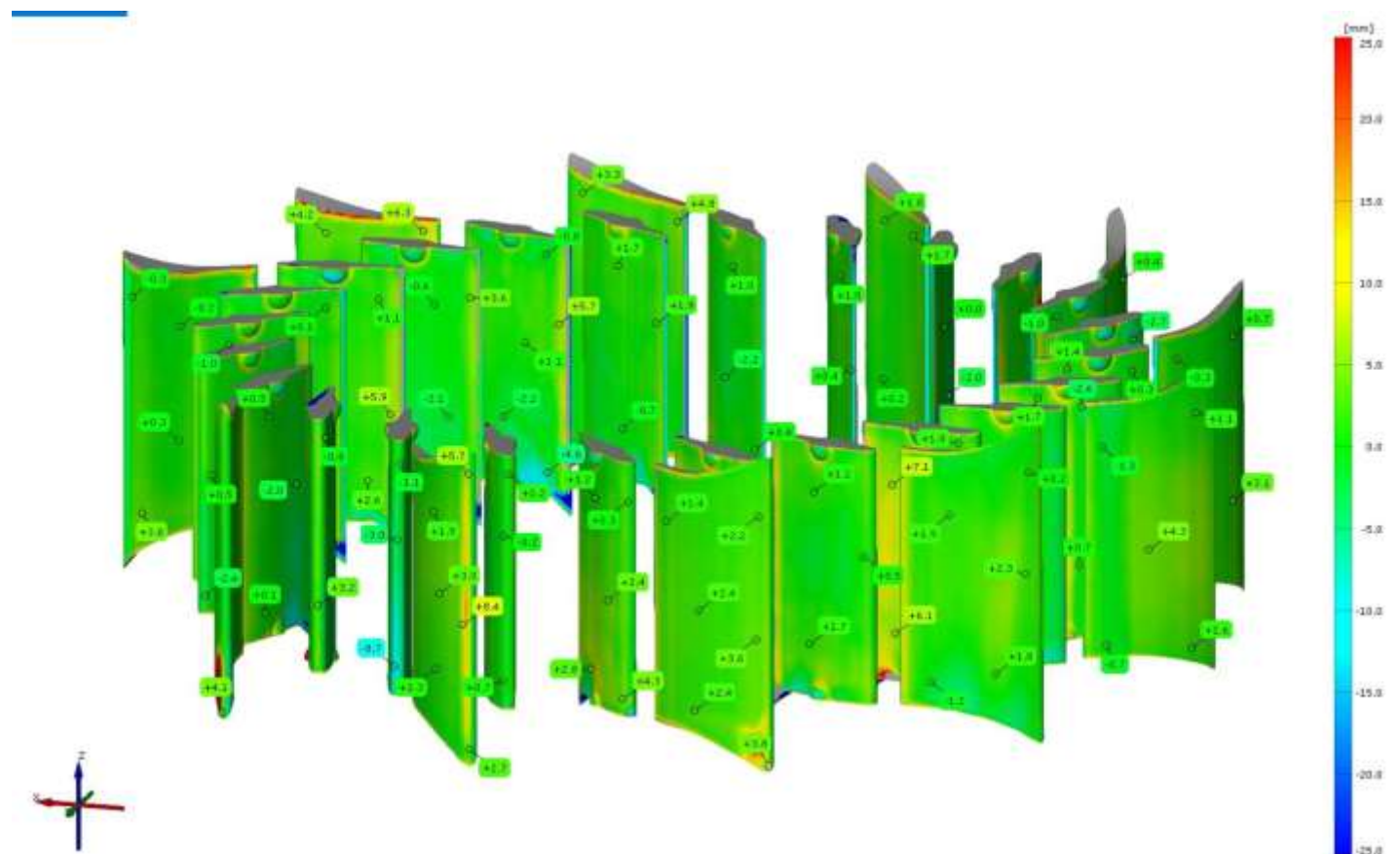
Examples – Power Station



Examples – Power Station



Examples – Power Station



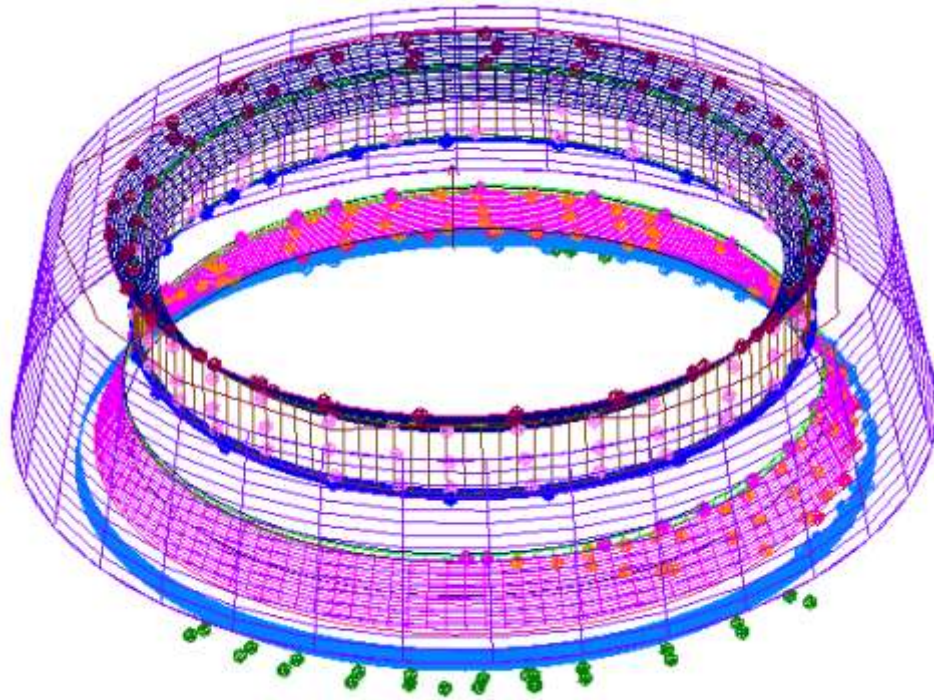
Examples – Ring

Scan:

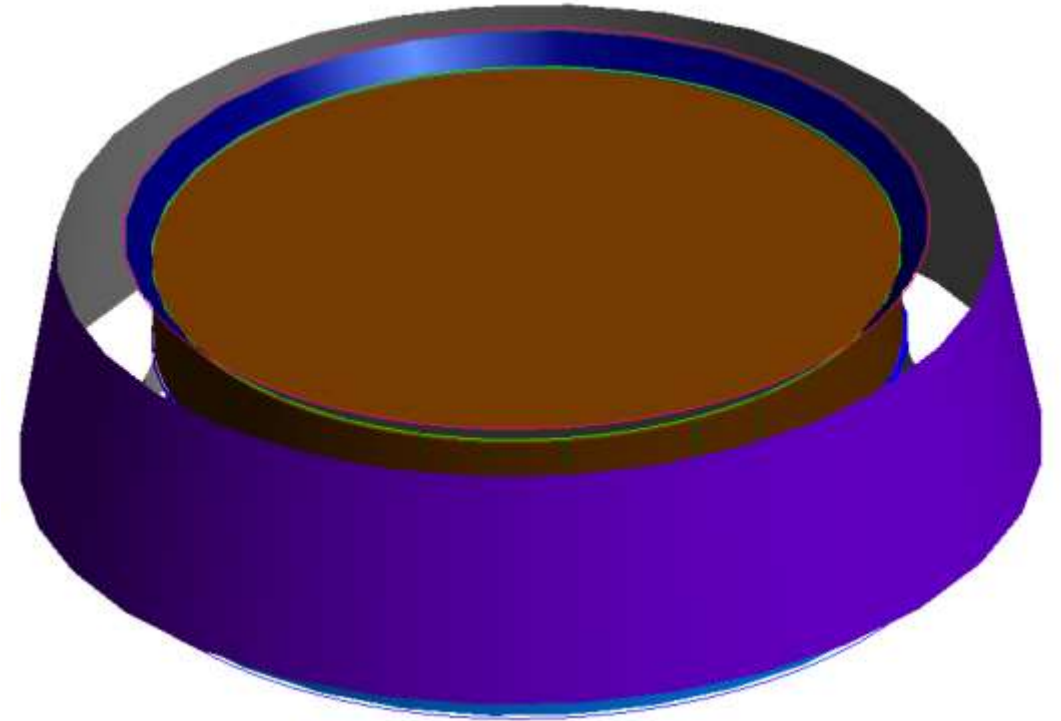


Examples – Ring

LT - Measurement:

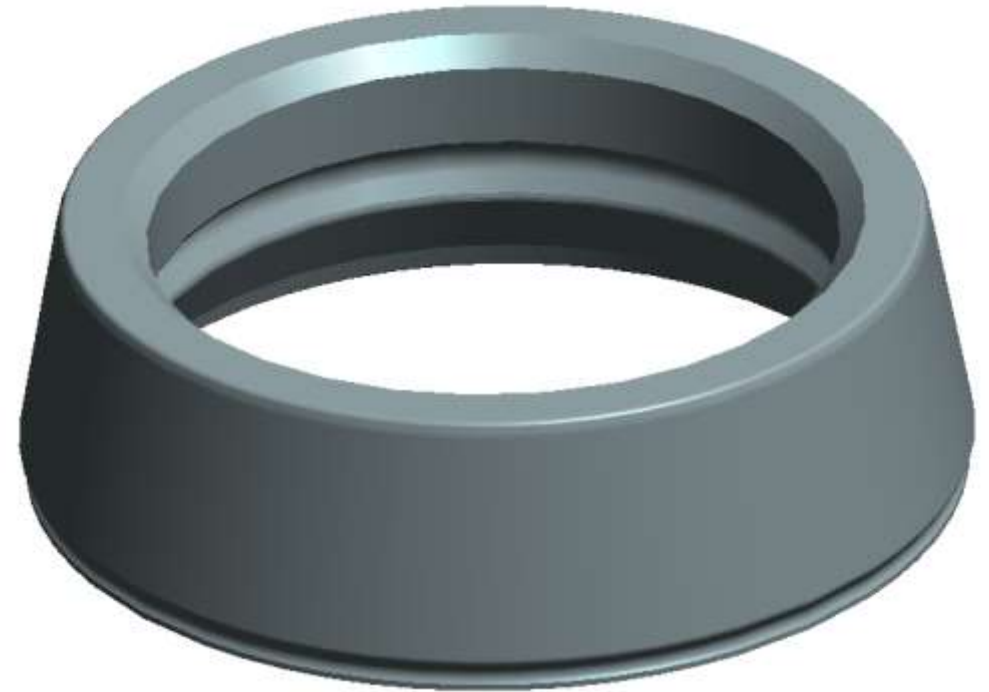
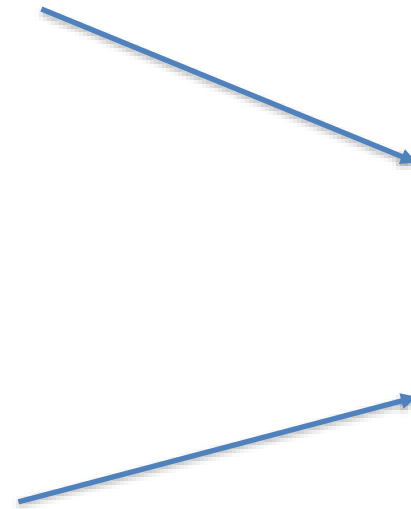
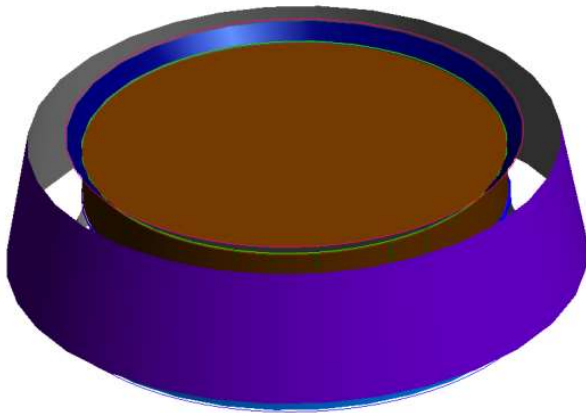


3D-Model:



Examples – Ring

Combined model:



Examples – Stator check

Stator core:

3D Laser Tracker
Actual geometry

Benefit:

Deviations of actual geometry
To nominal diameter



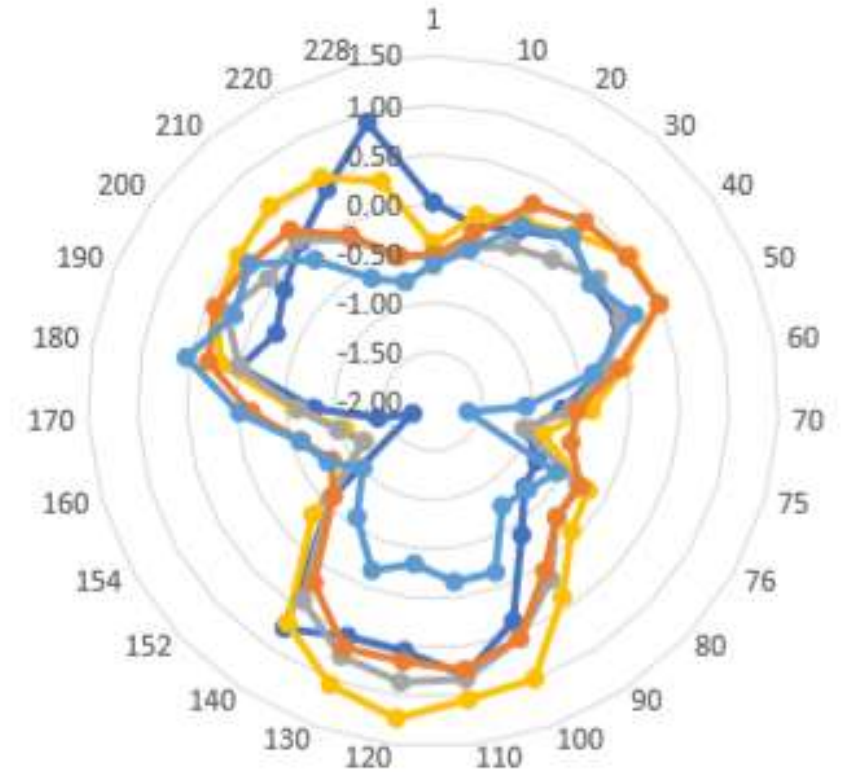
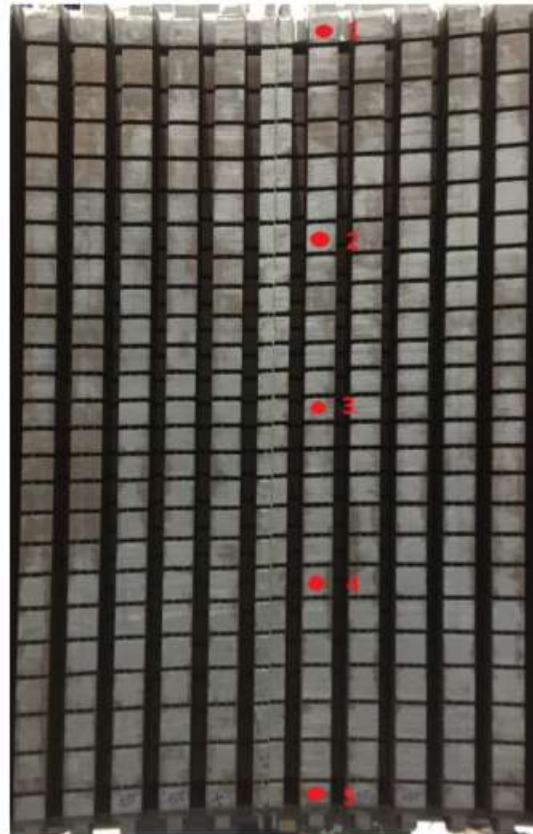
Examples – Stator check

Stator core:

3D Laser Tracker
Actual geometry

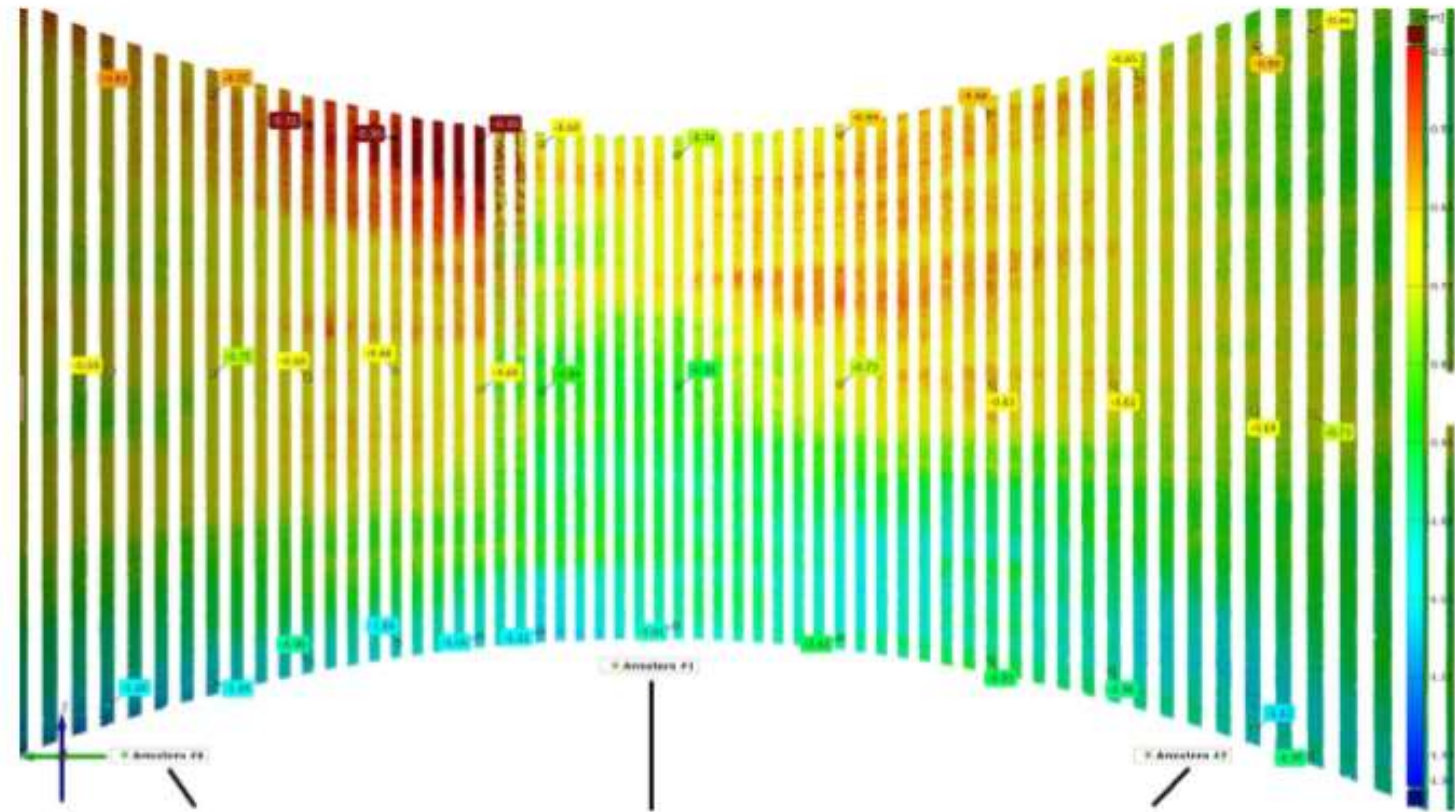
Benefit:

Deviations of actual geometry
To nominal diameter



Examples – Stator check

Deviation plot:



Thank you !

