Q: Alignment strategy and repeatability:
Best Fit or *3-2-1*?

SIGMA 3D

Position-PIN	Soll	Ist	Abw
X	258.26	258.28	0.02
Y	159.48	159.52	0.04
Z	253.22	253.16	-0.06

REF03	Soll	Ist	Abw
X	473.57	473.59	0.02
Y	424.91	424.94	0.03
Z	0.00	0.00	0.00

REF02	Soll	Ist	Abw
X	23.57	23.59	0.02
Y	424.91	424.92	0.01
Z	0.00	0.00	0.00

REF04	Soll	Ist	Abw
X	473.57	473.58	0.01
Y	74.91	74.92	0.01
Z	0.00	-0.03	0.03

REF01	Soll	Ist	Abw
X	23.57	23.57	0.00
Y	74.91	74.91	0.00
Z	0.00	0.00	0.00

welding-tool 100-times measured

Experiment description:

- **welding-tool** device measured **100 times** with a FARO Quantum-Arm 3.5 m (4 reference points and 1 position-pin)
- with these **measured raw-data** (coordinates), the **pin position** was calculated 100 times, once each with **3-2-1-alignment** and a **Best Fit - alignment** over REF-holes
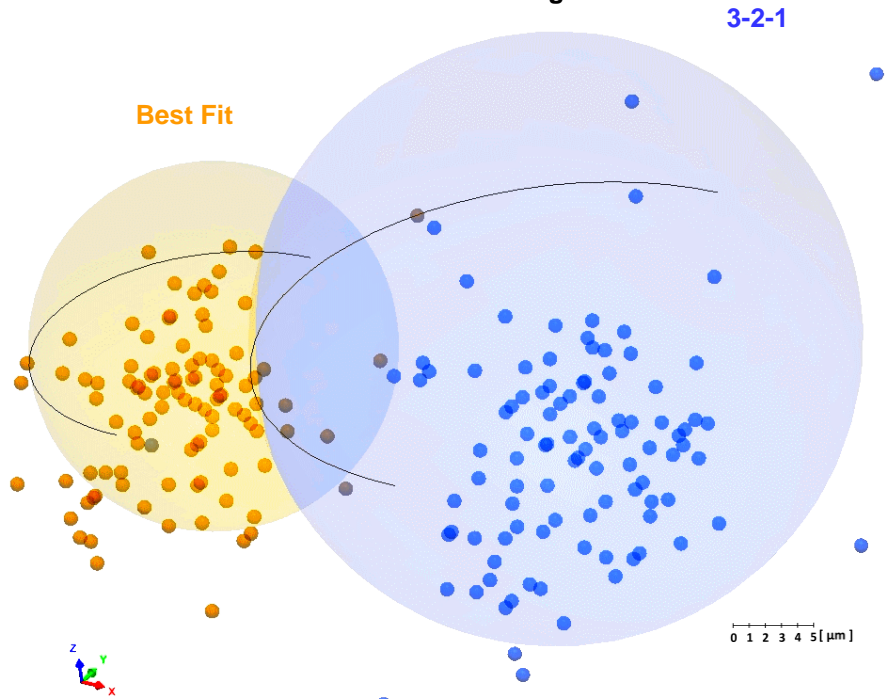- only the 100 calculated pin positions per alignment are considered (input data are the same
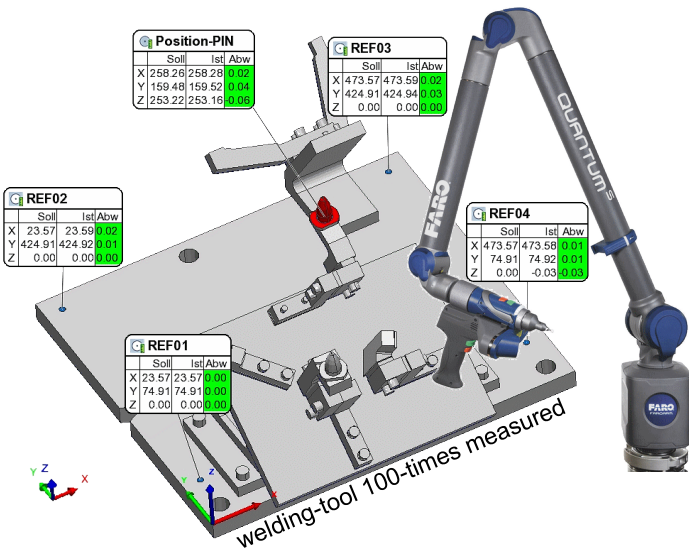
3D-positions of 100 PIN-measurements in different alignments

3-2-1 (REF-holes)

Objekt	X	Y	Z
REF01 ▾	☑	☑	☑
REF02 ▾	☐	☐	☑
REF03 ▾	☐	☐	☑
REF04 ▾	☐	☐	☐

Best Fit (REF-holes)

Objekt	X	Y	Z
REF01 ▾	☑	☑	☑
REF02 ▾	☑	☑	☑
REF03 ▾	☑	☑	☑
REF04 ▾	☑	☑	☑

Best Fit

3-2-1

0 1 2 3 4 5 [μm]

A: Best Fit Alignment delivers a significantly repeatable result!

Considered: Scattering (XYZ) of the 100 x calculated PIN position [mm]

PIN-1 X	StD	min	max	range
X-321	0.006	258.252	258.297	0.045
X-bestfit	0.005	258.247	258.270	0.023
Δ	0.001	0.005	0.027	**0.022**

PIN-1 Y	StD	min	max	range
Y-321	0.008	159.538	159.589	0.051
Y-bestf.	0.006	159.522	159.558	0.036
Δ	0.003	0.016	0.031	**0.015**

PIN-1 Z	StD	min	max	range
Z-321	0.005	253.157	253.189	0.032
Z-bestf.	0.004	253.167	253.191	0.024
Δ	0.001	-0.010	-0.002	**0.008**

range (max-min) [mm]