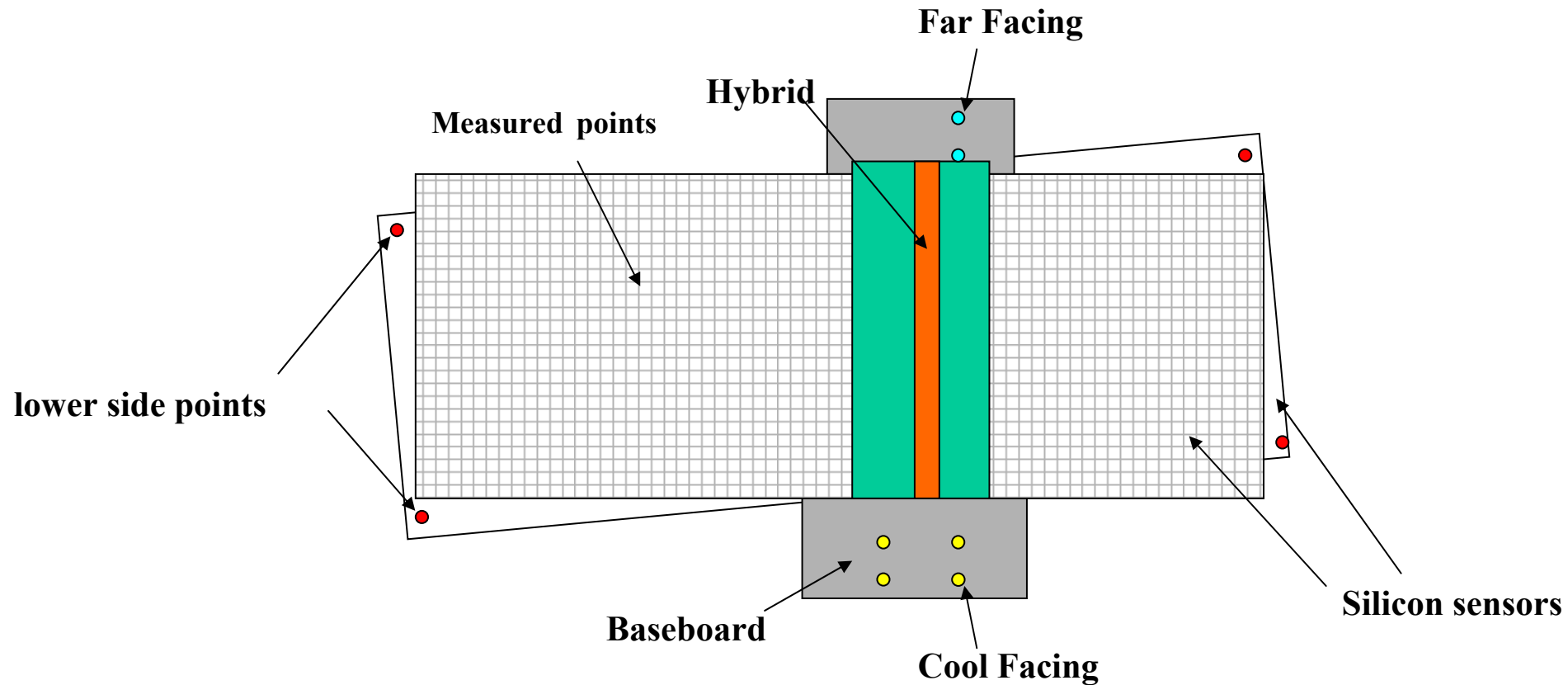


Regression fits to thermal deformation of modules

Z.Hicheur

27/07/2005

Module components - reminder

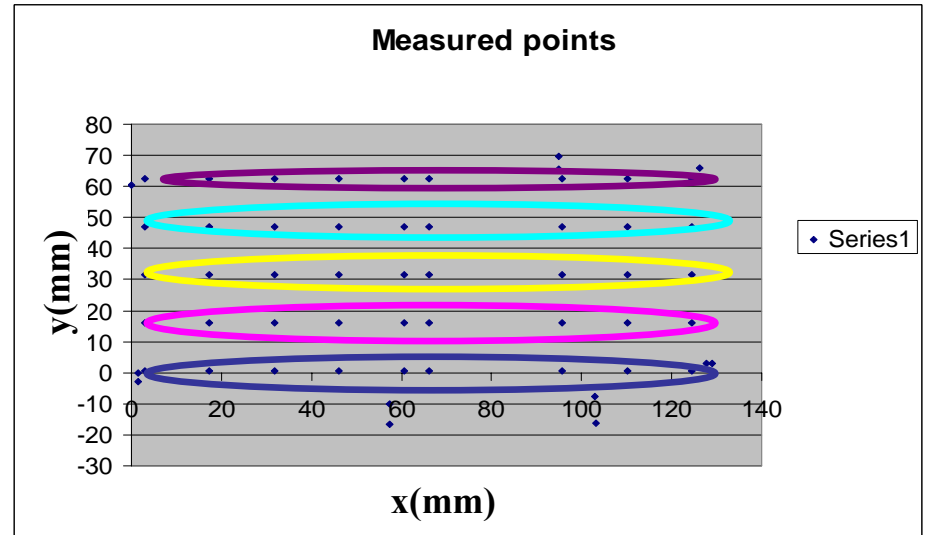
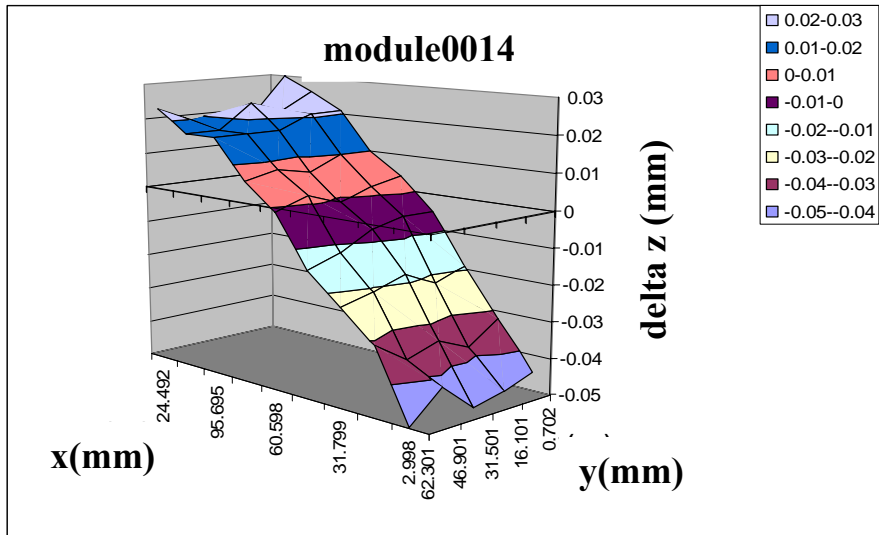


Regression fits

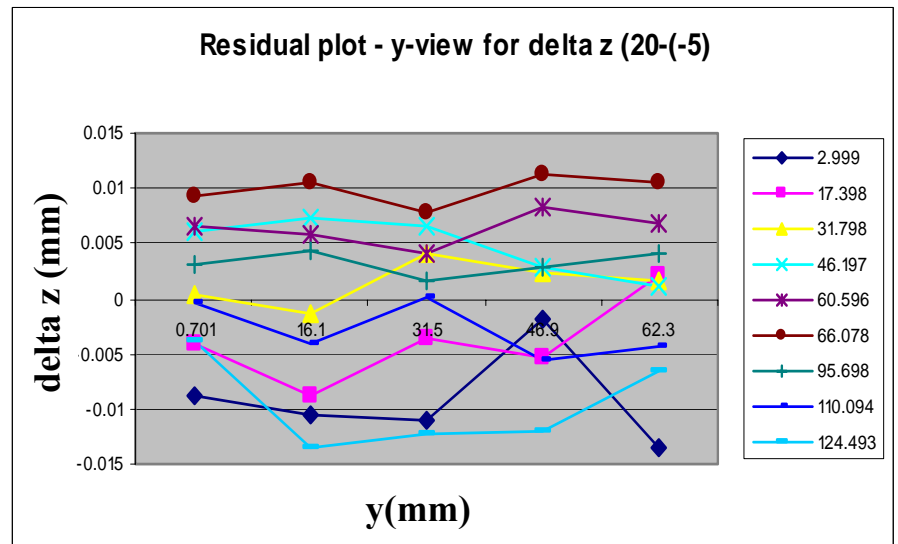
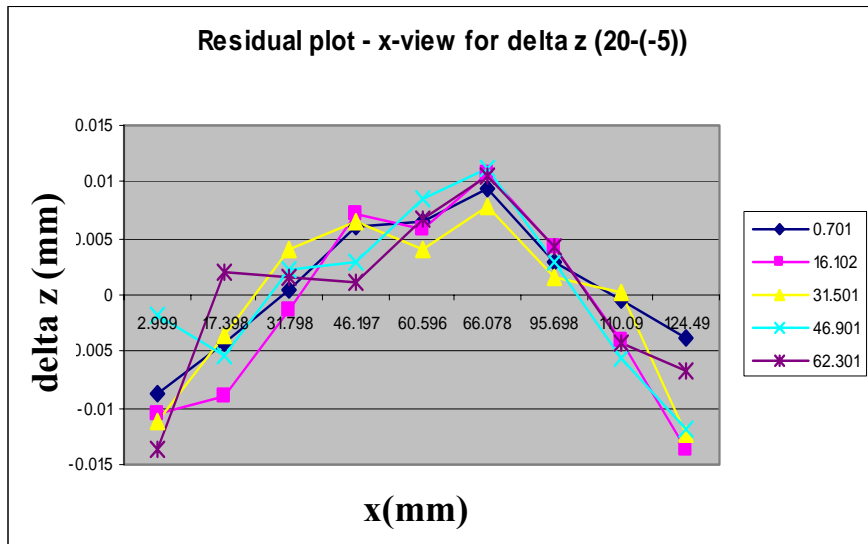
- Subtract the Z shapes of the module measured for temperature = 20°C and -5°C: obtain $\Delta Z(20-(-5))$ shape.
- Fit the best plane using least squares method, obtain plane $\Delta Z = a*x+b*y + c$.
- Compute the ΔZ residuals = difference between the points and their estimate on the plane.
- Plot the residuals in X and Y view to study the deviation from the plane.

Plan Fit and Residuals

(module0014)

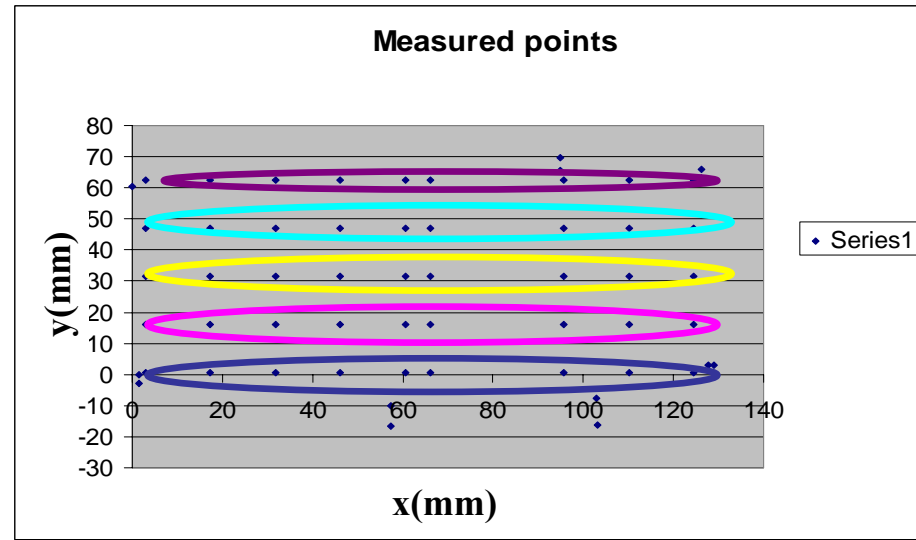
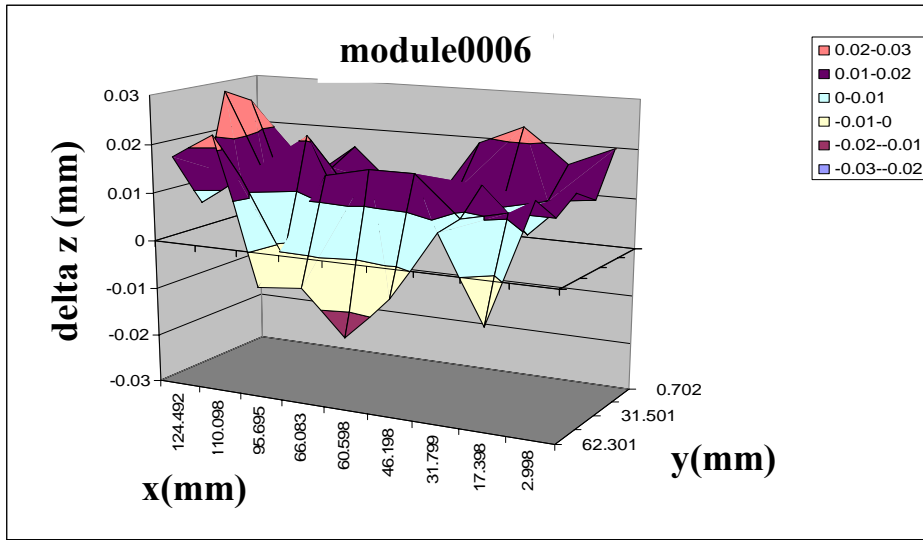


$a = (5.85 \pm 0.27) \times 10^{-4}$
 $b = (-8.40 \pm 4.92) \times 10^{-5}$
 $c = (-3.80 \pm 0.25) \times 10^{-2}$



Plan Fit and Residuals

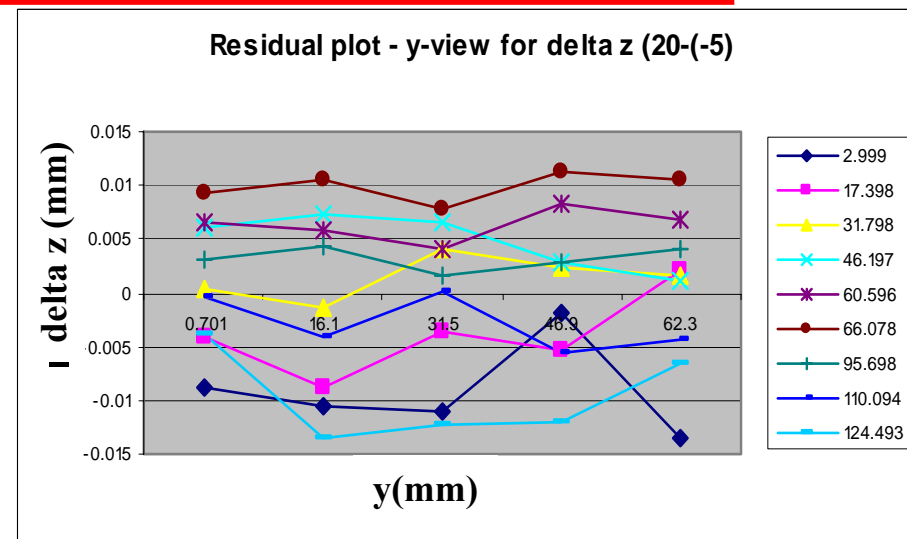
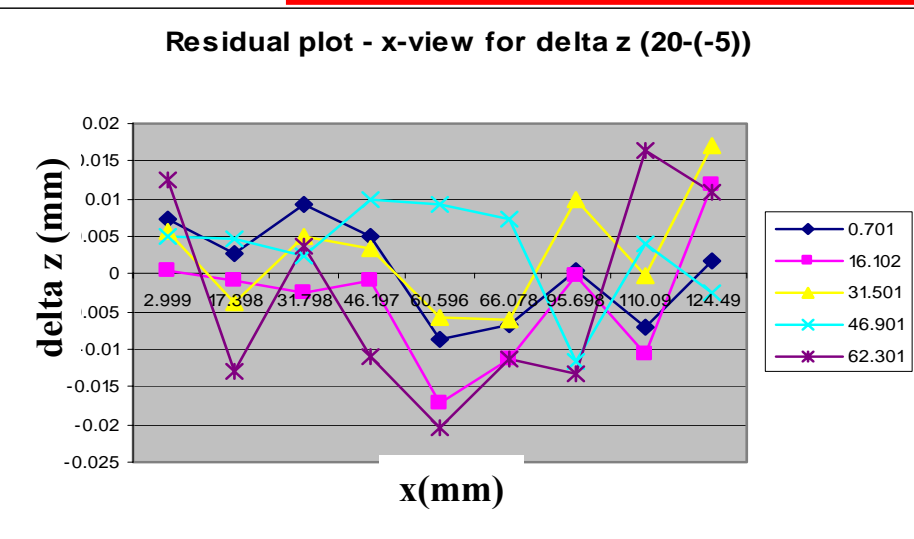
(module0006)



$$a = (2.92 \pm 3.49) \times 10^{-5}$$

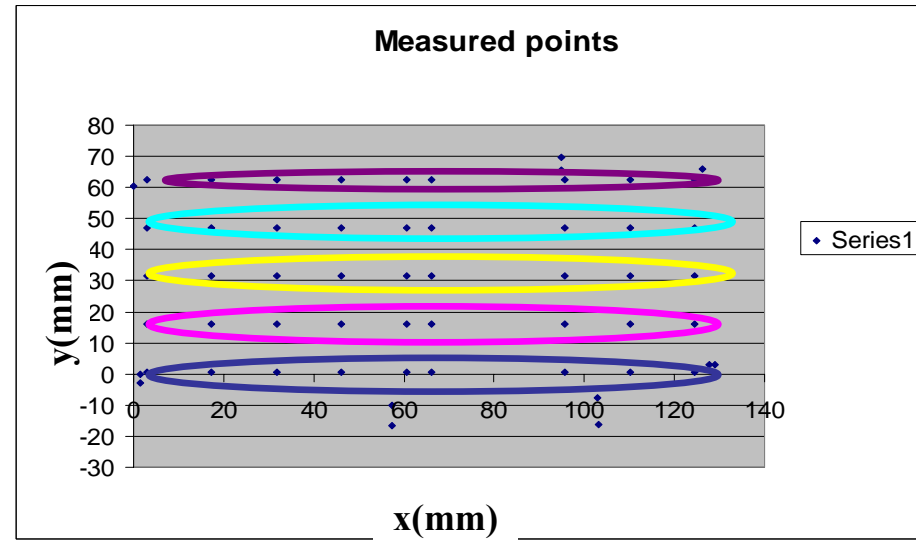
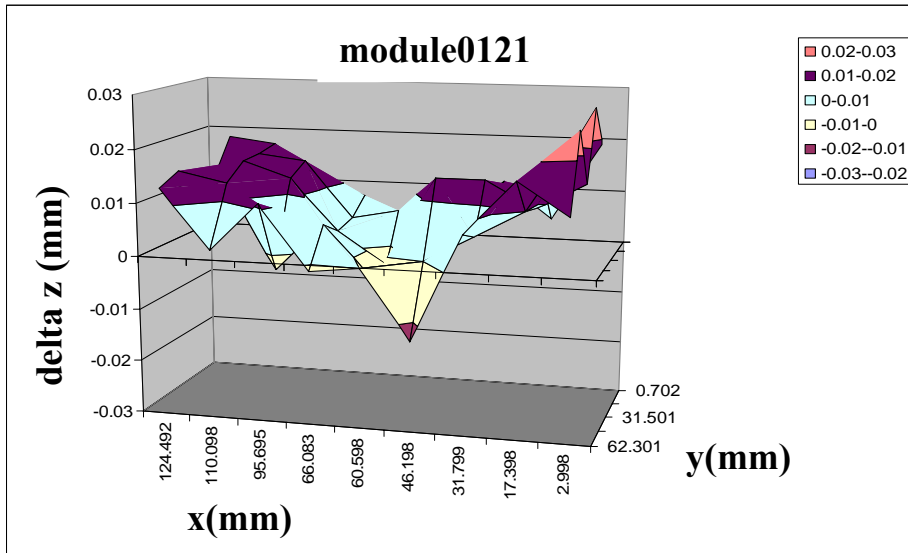
$$b = (-15.00 \pm 6.32) \times 10^{-5}$$

$$c = (1.28 \pm 0.32) \times 10^{-2}$$

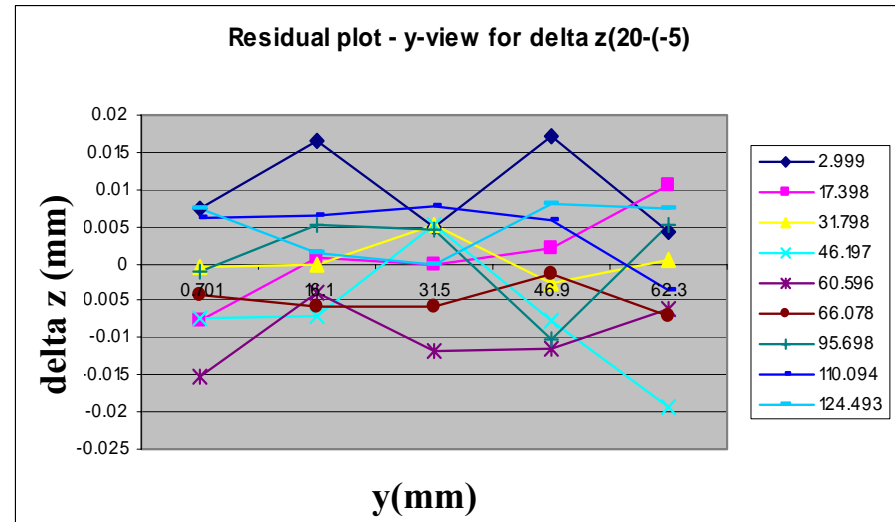
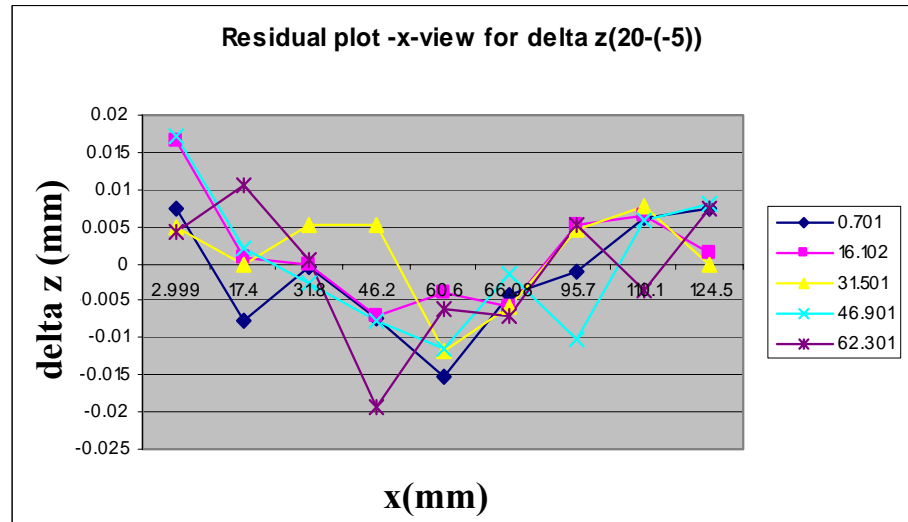


Plan Fit and Residuals

(module0121)

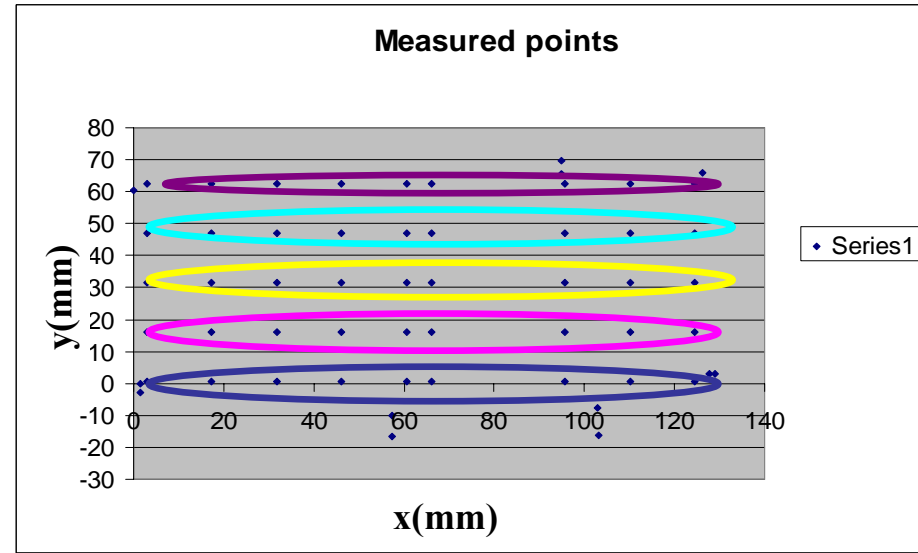
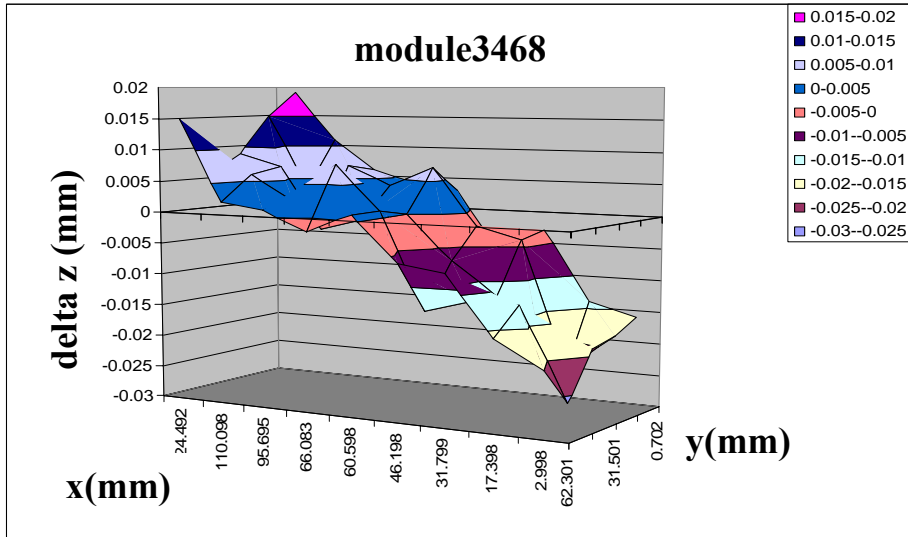


$a = (-8.5 \pm 30.1) \times 10^{-6}$
 $b = (-8.2 \pm 5.45) \times 10^{-5}$
 $c = (1.18 \pm 0.28) \times 10^{-2}$



Plan Fit and Residuals

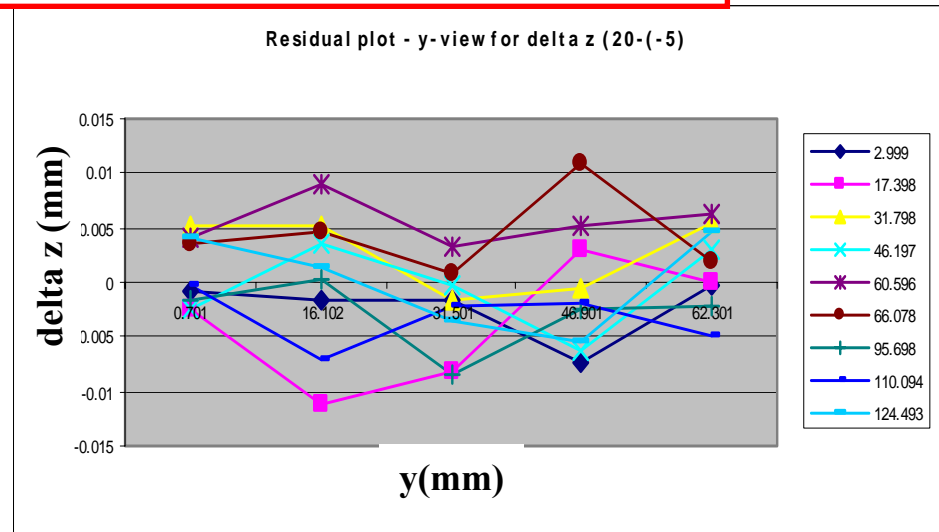
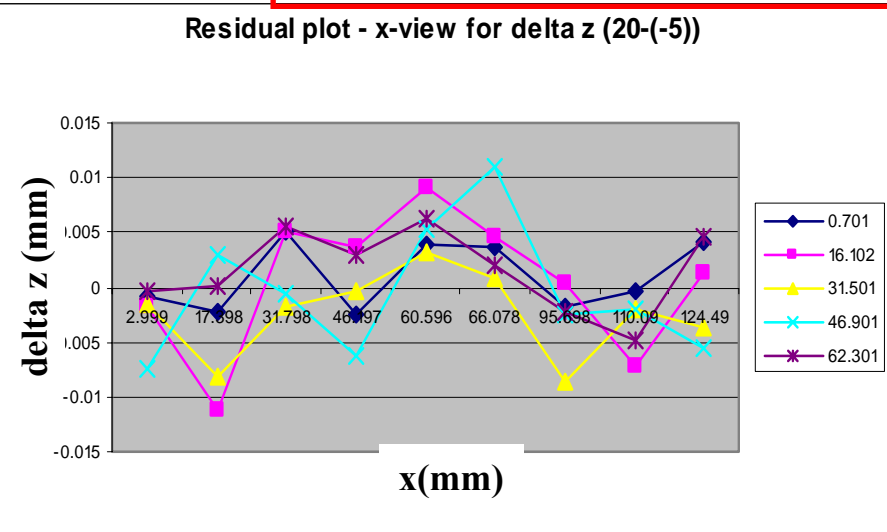
(module3468)



$$a = (2.47 \pm 0.18) \times 10^{-4}$$

$$b = (-7.10 \pm 3.36) \times 10^{-5}$$

$$c = (-1.59 \pm 0.17) \times 10^{-5}$$



Conclusion

- No systematic distortion but statistics low
- Fit to mean plane enabled to learn more
- Residual distributions show that the maximum deviation from a plane (linear distortion) is ± 20 microns.
- Hopefully more modules to come