FAST 3D OPTICAL-PROFILOMETER FOR THE SHAPE-ACCURACY CONTROL OF PARABOLIC-TROUGH FACETS

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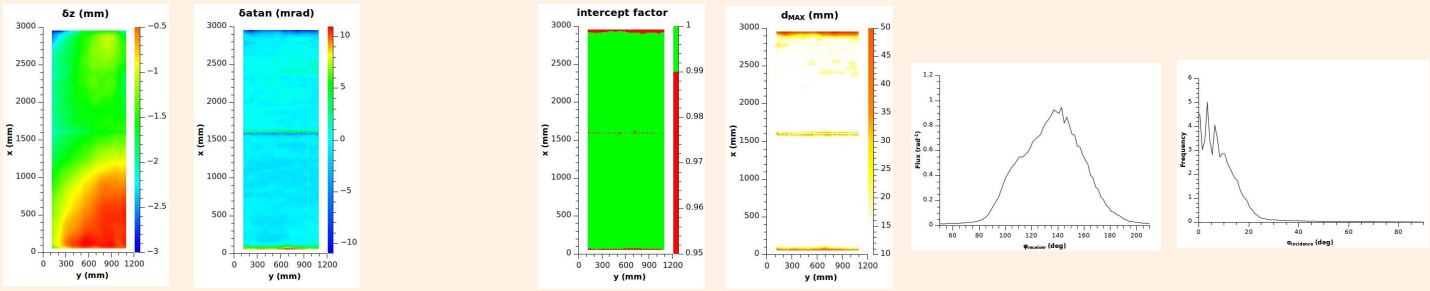
VISprofile features:

Scope: shape-accuracy verification of parabolic-trough facets in laboratory or industry; that gives the concentration effectiveness of the specimen.

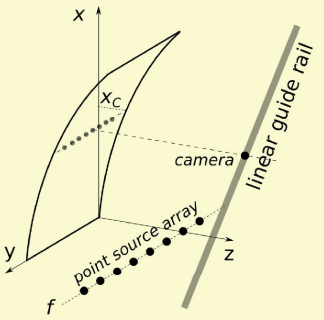
Measures: *x,y,z* ∂z/∂x and ∂z/∂y
→ VISprofile is a *profilometer* !!!

Evaluates by ray tracing: intercept-factor, dmax of reflected radiation from the focus line, flux and incident angle distribution on receiver surface

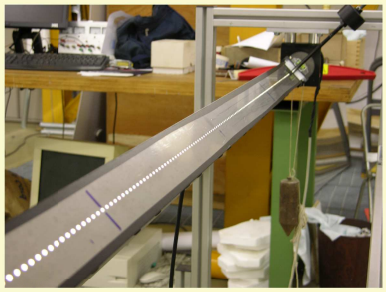


Experimental setup:

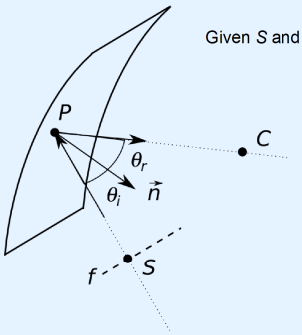

View from the camera: the linear array of point light source appears imaged on the reflective panel.




Hamamatsu C8484-05G on the motorized linear guide rail


Linear array of point light sources

Working:



Given *S* and *C*, *P* and the therein normal must fulfill

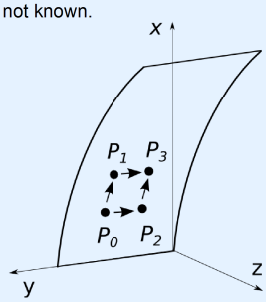
$$-\vec{SP}+\vec{PC}\propto\vec{n}$$

The normal is related to the partial derivatives

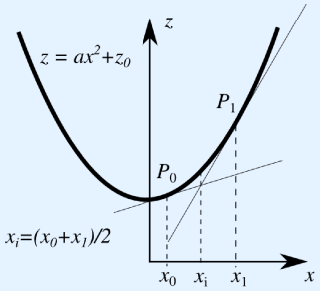
$$\vec{n}\propto\left(\frac{\partial z}{\partial x},\frac{\partial z}{\partial y},-1\right)$$

The scan consists of grabbing a number of frames varying the camera abscissa, so that during the scan the observed point-source-images span the whole facet-surface, from one linear edge to the opposite one.

Let P_0 be a point of the facet-surface of which *z* is known. Among its neighbor points, let us consider P_1: here x_1,y_1 are evaluated by the image itself, but z_1 is not known.



On the other hand, for an ideal parabolic profile, the planes tangent in P_0 and P_1 are expected to intersect one each other at midway. With this criterion position and derivative in P_1 are uniquely evaluated.



It is reasonable to extend this criterion also along y, so that z and the partial derivatives can be uniquely evaluated in the neighbor points of P_0.

The iterative application of this procedure allows to determine the shape of the whole facet-surface.

Strengths:

- **PROFILOMETER**: not only partial derivatives (∂z/∂x and ∂z/∂y) but also *z is* measured. The same can not claimed by V-SHOT and FRT
- **SIMPLICITY**: just 3 components (linear array of point light sources, motorized linear guide rail, FireWire camera)
- **LOW-COST**
- **FAST MEASURING & DATA PROCESSING**: 3 ms/point
- **HIGH ACCURACY**: better than 20 μrad and 50 μm for arctangent of derivatives and *z* deviation → superior than FRT instruments

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