DELFT UNIVERSITY OF TECHNOLOGY

Centroid computation

SC4045 CONTROL FOR HIGH RESOLUTION IMAGING

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1 CENTROID COMPUTATION

Devise a routine that *calculates the centroids of an intensity distribution* yielded by a (Shack-)Hartmann wavefront sensor. The next steps should be followed:

1. Given *a priori* knowledge of the number of lenslets/apertures that the sensor has and the ideal spot position (in the case where the phase is not aberrated), find the spots on the intensity distribution. (although this seems like a trivial task, if the aberration is very large some spots may shift a lot in the imaging plane.)

2. Notice that in [1, Eqs. 2.3-4], you are not told which pixel values (u, v) should you choose to perform the summation and compute the centroid. Compare different centroiding algorithms based on the analysis in [2]. Implement the one you find most suitable (after discussion with the teaching assistant).

3. After computing the centroid, find the expression to compute the wavefront slope based on the information in [3].

4. Come up with mechanisms that throw away the information of some apertures if the lighting is not enough or if a spot can't be found in the neghbourhood of its ideal position.

REFERENCES

[1] M. Verhaegen, "Lecture notes on control for High Resolution Imaging," May 2012.

[2] S. Thomas, "Optimized centroid computing in a Shack-Hartmann sensor," *SPIE*, vol. 5490, pp. 1238 – 1246, 2004.

[3] Spiricon, ed., *Hartmann Wavefront Analyzer Tutorial*. Spiricon, 2004.