Supplementary information for file AFTA C5 WFC Zernike and field Data 150428.xlsx

July 7, 2015

Explanation of Zernike coefficients

The wavefront error (WFE) is calculated at the exit pupil for the Cycle 5.0.6 design of each the Wide-field Imaging Mode (WIM) and the Wide-field Spectrometer Mode (WSM).

The wavefront error is fit to 22 terms of the Noll Zernike set. Using 22 terms, the fit error is less than 1 nm. The wavefront will include the design errors and a random set of errors which are representative of errors to be seen in the manufacture, alignment, thermal drift, and gravity release. The total wavefront error is equal to the current allocation in the error budget for the payload. These are representative and not intended to be final. The errors do not include jitter or drift.

90 nm for WIM
140 nm for WSM

Each row of the excel spreadsheet corresponds to a different field point/ wavelength combination. For the WIM and WSM, 90 field points are provided, corresponding to the center and the 4 corners of each of the 18 sensors. The WIM is sampled at 3 wavelengths for each filter. The WSM is sampled at 5 wavelengths.

The IFU consists of two slicers. Each slicer is sampled at three field points along 5 of the 21 slices. Each field point is sampled at 5 wavelengths. The WFE is produced at both the Slicer and Sensor Images:

Sensor WFE: 90 nm for IFU small slicer, 140 nm for IFU large slicer
Slicer WFE: 45 for the Fine slicer, Coarse is 80.

Explanation of Column Headingss (for tabs WIM, WSM, WSM grism 0th & 2nd order):

CNFG# = configuration number. This is a reference to the configuration number in the Zemax model creating the Zernikes.

Wave(um) = wavelength in microns

Field = the field number in the Zemax model

Local_x & Local_y = Position on the particular sensor in millimeters in the sensor local coordinates

Full_x & Full_y = X and Y location on the detector array (in millimeters). For IFU these are not given because there is only one sensor.

Ang_x(deg) & Ang_y(deg) = angle on the sky (in degrees) – Optical Reference Frame

RMS(wave) = RMS wavefront error in waves at the given wavelength

RMS(nm) = RMS wavefront error in nm

PV(waves) = Peak-to-Valley wavefront error in waves at the given wavelength

Z1, Z2..Z22 = The coefficient of the 1^{st}, 2^{nd},…22^{nd} term of the Noll Zernike set

Definition of Noll Zernike set given below.

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Z   1                    :   1
Z   2                    :    4^(1/2)  (p) * COS (A)
Z   3                    :    4^(1/2)  (p) * SIN (A)
Z   4                    :    3^(1/2)  (2p^2 - 1)
Z   5                    :    6^(1/2)  (p^2) * SIN (2A)
Z   6                    :    6^(1/2)  (p^2) * COS (2A)
Z   7                    :    8^(1/2)  (3p^3 - 2p) * SIN (A)
Z   8                    :    8^(1/2)  (3p^3 - 2p) * COS (A)
Z   9                    :    8^(1/2)  (p^3) * SIN (3A)
Z  10                    :    8^(1/2)  (p^3) * COS (3A)
Z  11                    :    5^(1/2)  (6p^4 - 6p^2 + 1)
Z  12                    :   10^(1/2)  (4p^4 - 3p^2) * COS (2A)
Z  13                    :   10^(1/2)  (4p^4 - 3p^2) * SIN (2A)
Z  14                    :   10^(1/2)  (p^4) * COS (4A)
Z  15                    :   10^(1/2)  (p^4) * SIN (4A)
Z  16                    :   12^(1/2)  (10p^5 - 12p^3 + 3p) * COS (A)
Z  17                    :   12^(1/2)  (10p^5 - 12p^3 + 3p) * SIN (A)
Z  18                    :   12^(1/2)  (5p^5 - 4p^3) * COS (3A)
Z  19                    :   12^(1/2)  (5p^5 - 4p^3) * SIN (3A)
Z  20                    :   12^(1/2)  (p^5) * COS (5A)
Z  21                    :   12^(1/2)  (p^5) * SIN (5A)
Z  22                    :    7^(1/2)  (20p^6 - 30p^4 + 12p^2 - 1)
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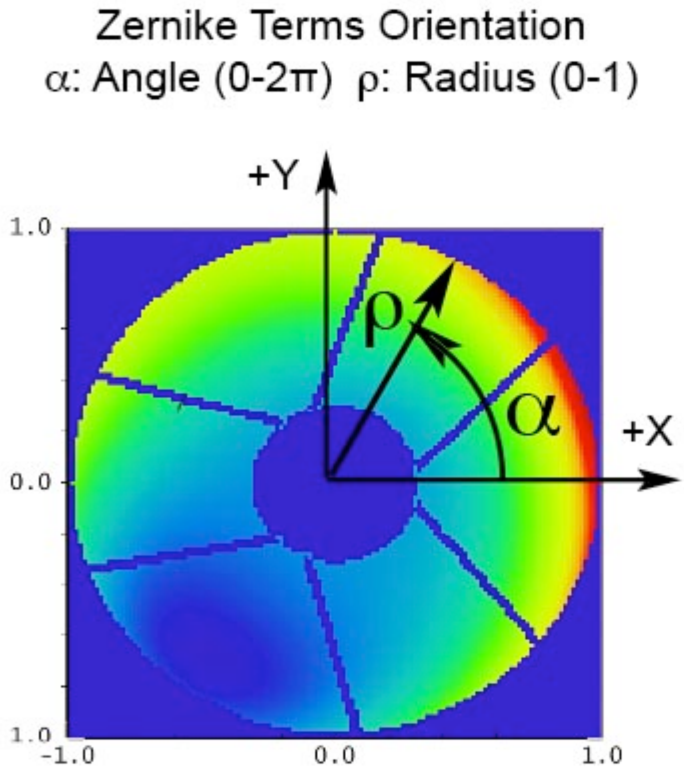

Explanation of columns for the WIM distortion map tab:

- s labels each SCA, same as CNFG number above.
- x,y label positions w/in each SCA, on scale of 1-15 in each dimension. The active area of each SCA is 40.88mm on a side.
- Center X, Center Y = position of the center of each SCA (mm), on the [Xfpa, Yfpa] axes shown in Figure 1.
- Xtarget, Y Target = coordinates of each point (9 per detector) in mm, in the [Xfpa, Yfpa] coordinate system shown in Figure 1.
- XAN target, YAN target = angles (degrees) corresponding to Center X, Center Y, assuming the mean plate scale corresponding to a focal length of 18500mm. These angles are defined in the [Xang, Yang] coordinate system shown in Figure 1.
- XAN_target = -(180/pi)*Xtarget(mm)/18500
- YAN_target = 0.617 - (180/pi)*Ytarget(mm)/18500
- Target = sqrt(XAN_Target^2 + YAN_Target^2)
- XAN, YAN = sky angles corresponding to XAN_Target, YAN_target, after accounting for distortion, (degrees).
- RSS = sqrt(XAN^2, YAN^2)
- Distortion = ((Target-RSS)/RSS)*100%

Thus, when converting between detector and sky angular positions, the following relations apply:

- R(sky) = R(det) / (1+D(Rdet))
- X(sky) = X(det) / (1+D(Rdet))
- Y(sky) = Y(det) / (1+D(Rdet))

The distortion is well-fit by the simple polynomial: D(Rdet) = 2.9754E-02R^2 + 4.4394E-03R - 1.5394E-02.