
# Deepspace Interplanetary Navigation Operations Colorado Research EXplorer (DINO C-REx)

# DINO C-REx Technical Memorandum

**Document ID: DINO_C-REx-Image Generation**

**SYSTEMS ENGINEERING REPORT 4.3A: METHOD FOR COLLECTING TC AND QE DATA.**

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| **Status:** Initial Version |
| **Scope/Contents** |
| User documentation for the DINO C-REx Camera Module. |

| **Rev**: | **Change Description** | **By** |
|---|---|---|
| 1.0 | Initial Release | Beryl Yu-Hsuan Kuo |
| 1.1 | Converted to DINO C-REx LaTex Style | Matt Muszynski |

# Contents

# 1 Overview

In order to facilitate the use of DINO C-REx's camera module, the camera team thought it would be useful to provide a number of numpy save files with transmission and quantum efficiency curve data out-of-the box for the user. This SER documents the method used to collect the data, the CCDs and lenses modeled, and the files data was saved to within DINO C-Rex.

# 2 Method

Use MATLAB as tool to get the data of curve from the picture. The basic method is unit conversion, converted pixel to number.

1. input picture: type file name and file type into imread(file name. file type)
2. set up range: use command ginput(number) to set maximum and minimum value of x and y. In this step, MATLAB will automatically point out the pixel of the location of maximum and minimum x and y point
3. click on along the curve: input the number of points needed into ginput(number), and click on along the curve
4. get value of x and y: the points clicked on last step will go through the unit conversion function from pixel to number, and the result will show in workspace.

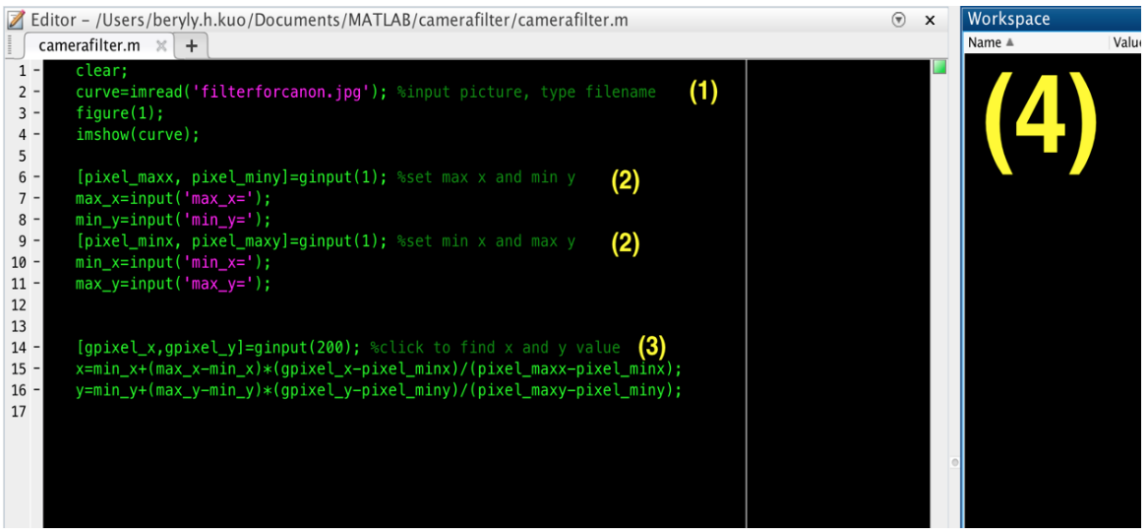


**Fig. 1:** Method for calculating python dictionary data from TC/QE curve images.

# 3 Steps

1. Type Matlab filename into command window and the figure typed in the code will show up as shown in fig 2
2. Click the maximum X and minimum Y point in the figured and the value in command window as shown in figure 3
3. Click the minimum X and minimum Y point in the figured and the value in command window as shown in figure 4

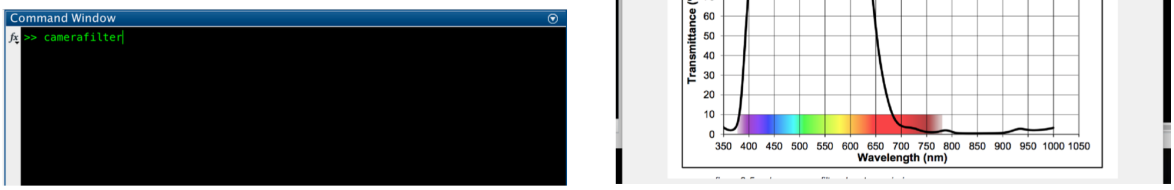


**Fig. 2:** Method step 1.

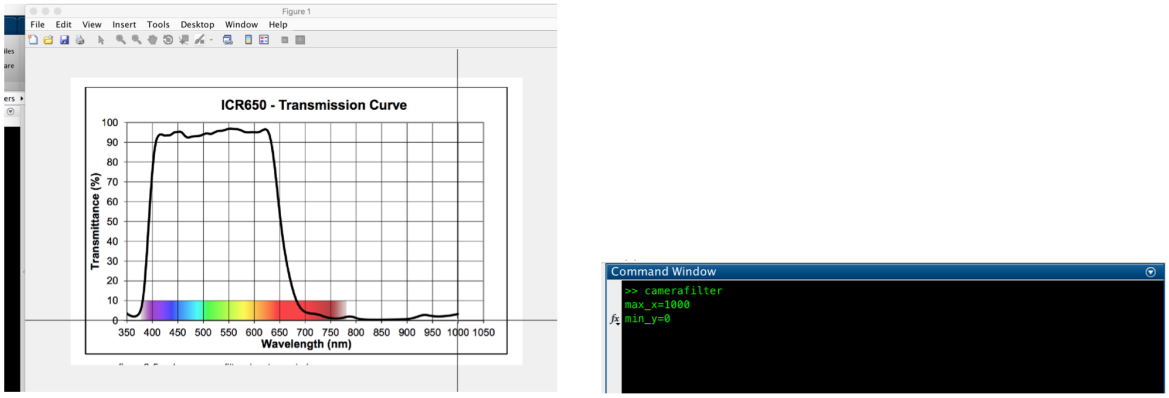


**Fig. 3:** Method step 2.

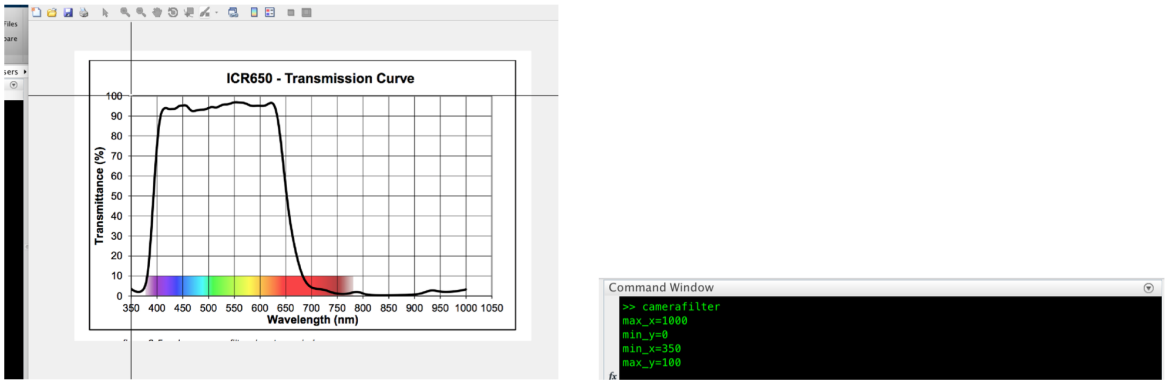


**Fig. 4:** Method step 3.

4. Step 2 and 3 is to box out the range, and type in the value. Therefore, Matlab can help to do unit convert from pixel to unit we set.

5. Click along the graph on the picture (as many as you can, but no repeat X value) as shown in figure 5

6. Can get the result in the workspace as shown in figure 6

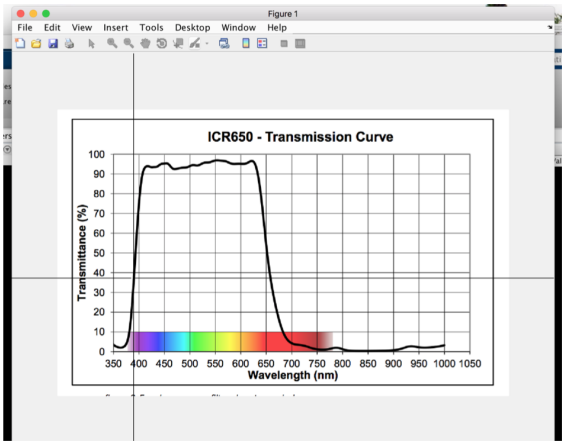


**Fig. 5:** Method step 5.


**Fig. 6:** Method step 6.

7. Point twice to show in command window as shown in figure 7

# 4 Source

Camera Transmission curve

1. File name: 1020D
   From: Catching The Light > DSLR Cameras and Hydrogen-Alpha Emission nebulas, Filters http://www.astropix.com/html/i_astrop/dslr_ha.html transmission curve for Canon 10D and 20D

2. File name: ICR650
   From: XiQ 3.0 camera series manual book p.18
   https://www.ximea.com/downloads/usb3/manuals/xiq_technical_manual.p df transmission curve for ICR-650

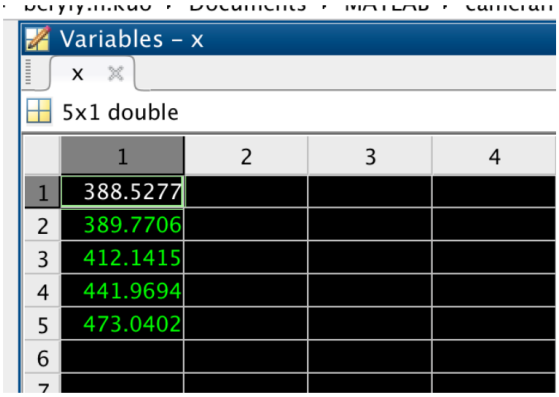


**Fig. 7:** Method step 7.

3. File name: filterforcanon
   From: Astrodon Inside ¿ Astrodon Premium DSLR Replacement UV/IR filter
   http://www.imaginginfinity.com/astrodonfilters.html filter for Canon DSLR cameras

QE Curve

1. File name: Hubble CCD From: Wikipedia, Quantum Efficiency
   https://en.wikipedia.org/wiki/Quantum_efficiency
   Hubble WFPC2 QE curve

2. File name: varietyCCDs
   From: Handbook of CCD Astronomy p.39
   QE curve for variety CCDs curves

3. File name: CCD Spectral Sensitivities
   From: Hamamatsu ¿ Concepts in Digital Imaging Technology Quantum Efficiency
   http://hamamatsu.magnet.fsu.edu/articles/quantumefficiency.html CCD spectral sensitivities(QE) curves

# 5 Extra Information for CCD QE Curves

1. WFPC2: Hubble former camera

2. CAT-C: new generation SITe CCD used in mosaic imager at the University of Arizona 90 telecope on Kitt Peak

3. MIT-LL: produced at MIT Lincoln Laboratories and optimized for red observations

4. ACS: Hubble Space Telecope Advanced Camera for Surveys SITe CCD

5. LBL: Lawrence Berkeley Lab high resistivity, "deep depletion" CCD with high red QE

6. MAT: front-side, processed CCD showing high blue Q From Handbook of CCD Astronomy p.39

# 6 Recommendation

CCD of Hubble has some problem of charge-transfer efficiency. There are some signals will miss while transferred. So, the objects will appear fainter in higher row numbers than in low row numbers. Therefore, CCD of Hubble is not recommended.