

# F-18' & Linear Spatial Filtering in Real-Time

The F-18 could be used, in an FPGA, to perform linear spatial filtering of images in real-time. This is useful for correcting the output images of CCD cameras

# Introduction

- Digital Image Processing
- Charge-Coupled Device (CCD)
- Dark Current
- Flat Field
- Optical Aberrations

# Digital Image Processing

- It is like signal processing but in two dimensions. In other words, spatial frequencies, instead of temporal.
- Analog filters to Digital filters: Z-transform
- Fast Fourier Transform (FFT) in two dimensions
- FFT  $\rightarrow$  Filter  $\rightarrow$  Inverse FFT
- Convulsion

# Dark Current

- CCD is exposed to complete darkness
- CCD Readout: Bucket Brigade
- Bucket, as read, don't completely empty
- As each dark pixel is read, the residual count increases

# Flat Field

- Each CCD pixel has it's own response to light
- Dark Current
- Sensitivity
- Saturation

# Optical Aberrations

- Distortion
- Spherical Aberrations
- Coma
- Astigmatism
- De-focus
- Zernike Polynomials

# Kernel

- Digitized version of an analog filter
- Usually dimensions as an odd-numbered, square matrix
- The kernel is placed in the upper right corner of the image.
- The pixels covered by the kernel are multiplied by the corresponding kernel value.
- The resulting products are summed.
- The sum is divided by the sum of the kernel values
- The quotient replaces the central pixel.