

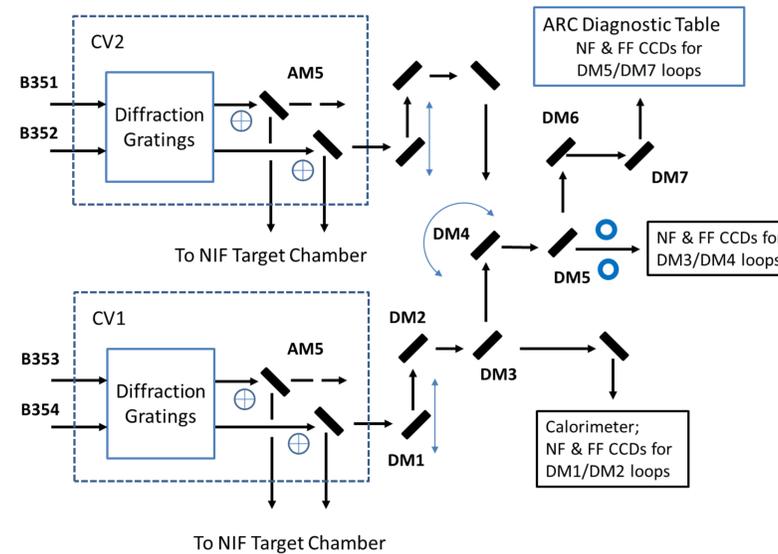
# Image Analysis for the Automated Alignment of the Advanced Radiography Capability (ARC) Diagnostic Path

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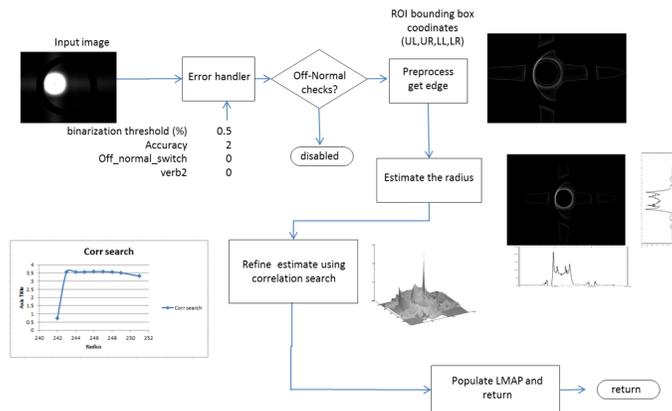
## Abstract

The Advanced Radiographic Capability (ARC) at the National Ignition Facility was developed to produce a sequence of short laser pulses that are used to backlight an imploding fuel capsule. This backlighting capability will enable the creation of a sequence of radiographs during capsule implosion and provide an unprecedented view into the dynamics of the implosion. A critical element of the ARC is the diagnostic instrumentation used to assess the quality of the pulses. Pulses are steered to the diagnostic package through a complex optical path that requires precision alignment. A central component of the alignment system is the image analysis algorithms, which are used to extract information from alignment imagery and provide feedback for the optical alignment control loops. Alignment imagery consists of complex patterns of light resulting from the diffraction of pilot beams around cross-hairs and other fiducials placed in the beam path. This paper describes the alignment imagery for two ARC automated alignment loops, and the image analysis algorithms used to extract information required for the operation of those loops.

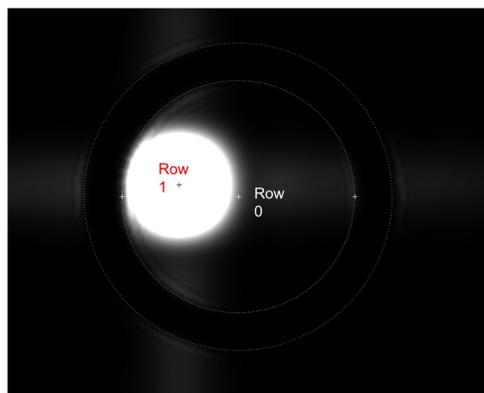
## ARC Diagnostic Path



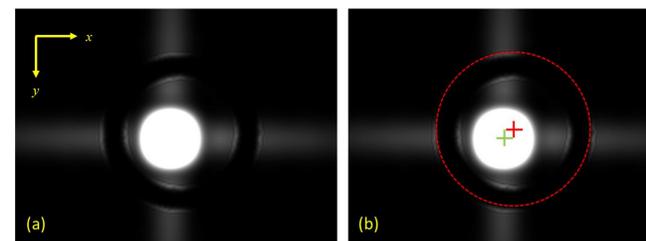
## DM3/DM4 Centering loop image processing



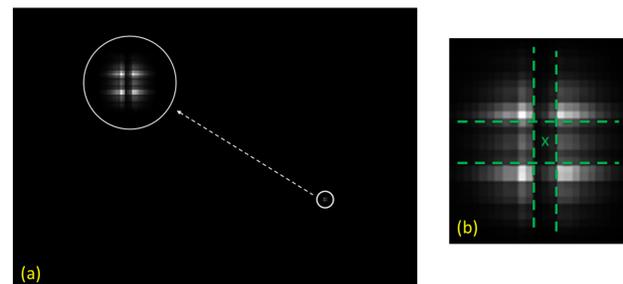
## Results



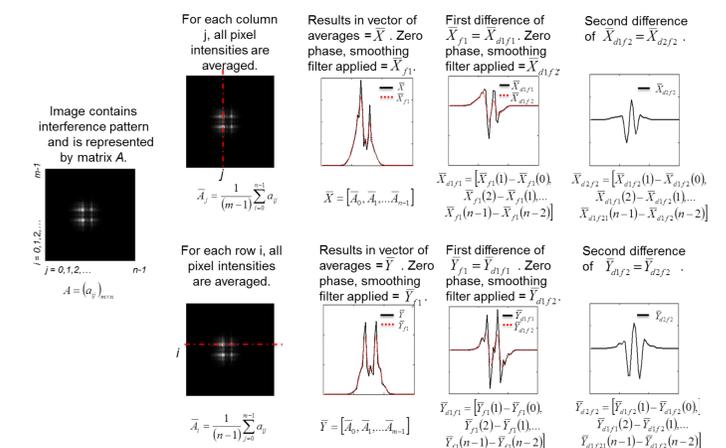
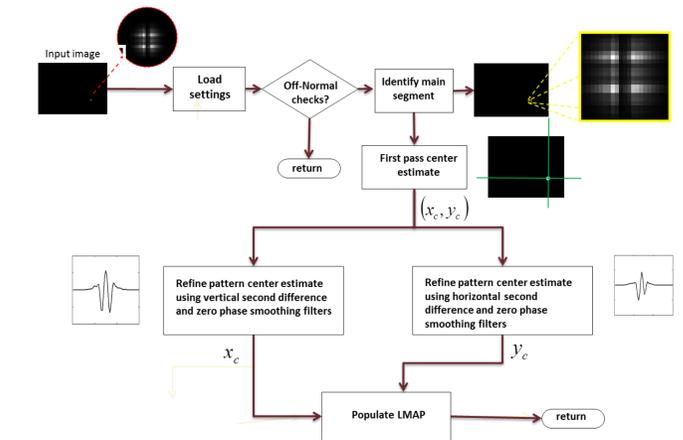
## DM3/DM4 Centering image



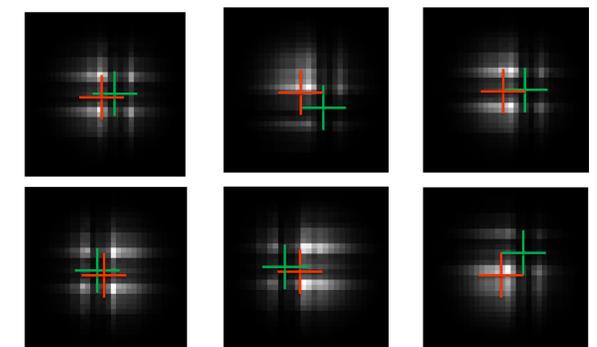
## DM5/DM7 Centering image



## DM5/DM7 Centering loop image processing



## Results



## Algorithm development with synthetic imagery

- Synthetic imagery used to develop the ARC Diagnostic Path image processing algorithms
- Algorithm development and hardware implementation proceeding in parallel
- Synthetic imagery created from optical models of diagnostic path using FRED optical engineering software. (FRED is made by Photon Engineering.)
- Algorithms will be modified (if needed) when real imagery is available

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