

# BeatMark Software to Reduce the Cost of X-Ray Mirror Fabrication by Optimization of Polishing and Metrology cycle, Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)



## ABSTRACT

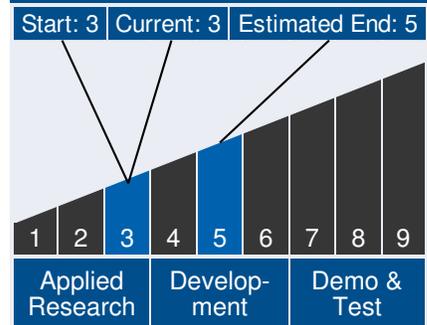
For X-Ray optics, polishing the mirrors is one of the most costly steps in the fabrication of the system. BeatMark software will significantly decrease the cost of X-Ray mirror production. BeatMark will allow for parametrization of surface metrology data, which will be used as feedback for polishing parameter optimization and metrology experiment planning. By providing the parametrized optical surface description, BeatMark will optimize the costly polishing-and metrology cycle and enable numerical simulation of the performance of new X-Ray mirrors performed by NASA. BeatMark will help fulfill the requirements for sophisticated and reliable information about the expected surface slope and height distributions of prospective X-Ray optics before the optics are fabricated. As we demonstrated in Phase I, an optical surface can be thought of as a stationary uniform stochastic process and modeled with optimal Invertible Time Invariant Filters (InTILF). It was further shown that the modeling of one-dimensional (1D) slope measurements allows highly confident fitting of the X-Ray mirror metrology data with a limited number of parameters and a 10-15% reduction of required length of metrology profiles. Theoretically, a reduction of 50% is possible. In Phase II, we will conduct field tests to assess what reduction in metrology is practical and implementable. With the parameters of the InTILF model developed in Phase I, the surface slope profile of optics with a new specification can be forecast reliably. BeatMark will also process 2-D metrology data and provide a polishing optimization method, based on analysis of the mirror quality response to the polishing parameters. Our Phase I studies indicated that the optimal InTILF modeling describes the mirror surfaces with very few filter parameters and high spectral accuracy.



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### Technology Maturity



### Management Team

#### Program Executives:

- Joseph Grant
- Laguduva Kubendran

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## ANTICIPATED BENEFITS

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### To NASA funded missions:

Potential NASA Commercial Applications: The primary NASA application for the BeatMark software is to reduce the fabrication and testing time and cost for optics to be used in the X-Ray Surveyor Mission. By optimizing the polishing-and-metrology cycle, BeatMark will reduce the cost of manufacturing the mirrors, which will contribute to the approval and success of the mission. Other NASA applications include surface metrology for other X-Ray and ultraviolet optics for astronomy and communication applications.

### To the commercial space industry:

Potential Non-NASA Commercial Applications: When BeatMark has proven its effectiveness through practical implementation in Phase II, other applications for the software will include X-Ray mirror polishing for applications such as medical imaging and teletherapy for cancer treatment, UV mirrors polishing, surface metrology analysis for lithography and other manufacturing processes with tight tolerances for surface finish, imaging texture analysis, and composition analysis.

## Management Team (cont.)

### Program Manager:

- Carlos Torrez

### Principal Investigator:

- Anastasia Tyurina

## Technology Areas

### Primary Technology Area:

Science Instruments,  
Observatories, and Sensor  
Systems (TA 8)

└ Observatories (TA 8.2)

└ Mirror Systems (TA 8.2.1)

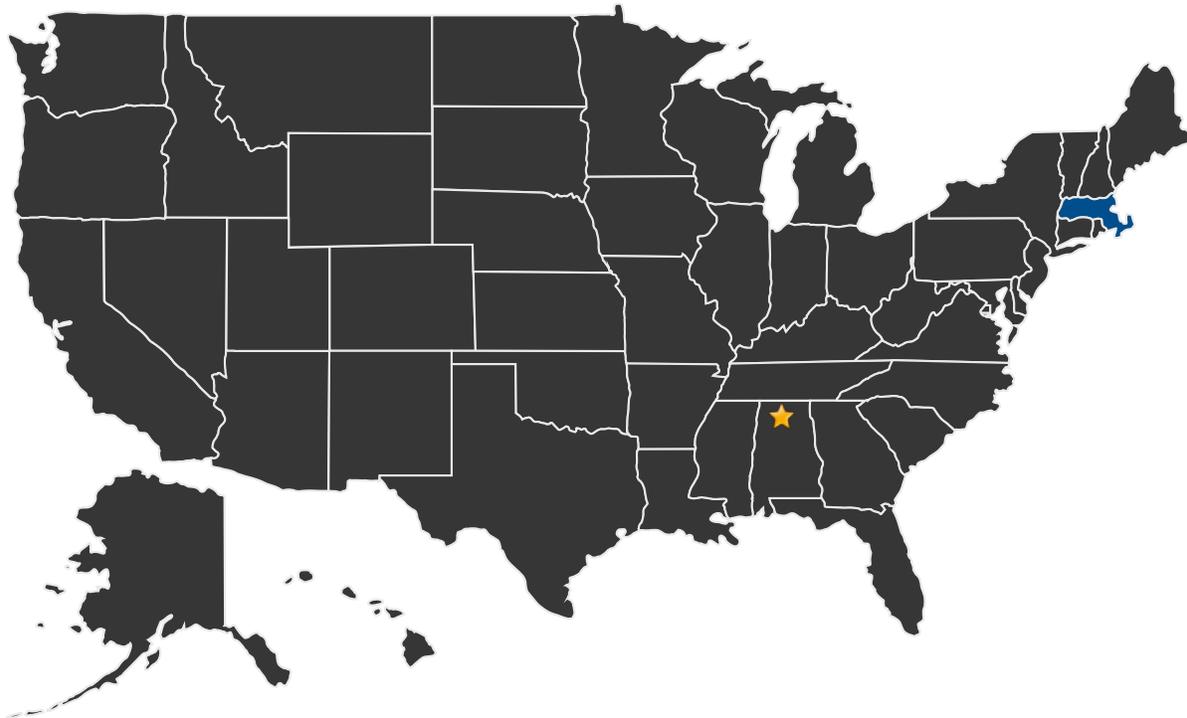
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## U.S. WORK LOCATIONS AND KEY PARTNERS

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■ U.S. States With Work

★ **Lead Center:**  
Marshall Space Flight Center

### Other Organizations Performing Work:

- Second Star Algonumerix (Needham, MA)

## PROJECT LIBRARY

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### Presentations

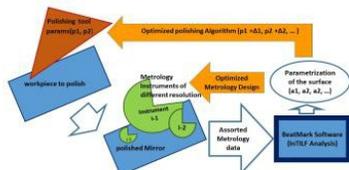
- Briefing Chart
  - (<http://techport.nasa.gov:80/file/23558>)

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## IMAGE GALLERY



*BeatMark Software to Reduce the Cost of X-Ray Mirror Fabrication by Optimization of Polishing and Metrology cycle, Phase II*

## DETAILS FOR TECHNOLOGY 1

### Technology Title

BeatMark Software to Reduce the Cost of X-Ray Mirror Fabrication by Optimization of Polishing and Metrology cycle, Phase II

### Potential Applications

The primary NASA application for the BeatMark software is to reduce the fabrication and testing time and cost for optics to be used in the X-Ray Surveyor Mission. By optimizing the polishing-and-metrology cycle, BeatMark will reduce the cost of manufacturing the mirrors, which will contribute to the approval and success of the mission. Other NASA applications include surface metrology for other X-Ray and ultraviolet optics for astronomy and communication applications.