

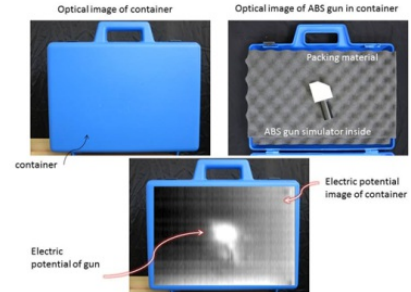
# Electric Field Imaging Project

Nondestructive Evaluation Program | Office Of Safety And Mission Assurance (OSMA)



## ABSTRACT

NDE historically has focused technology development in propagating wave phenomena with little attention to the field of electrostatics and emanating electric fields. This work is intended to bring electrostatic imaging to the forefront of new inspection technologies, and new technologies in general. The specific goals are to specify the electric potential and electric field including the electric field spatial components emanating from, to, and throughout volumes containing objects or in free space.



ABS plastic gun detected with with EFI technology. Credit: NASA/LaRC

## ANTICIPATED BENEFITS

### To NASA funded missions:

#### All missions

- \* Electrostatic discharge (ESD) control requirements
- \* Electronic signature requirements, as received and damaged materials characterization requirements,
- \* Vehicle and component charging requirements
- \* Design and construction of unique electronic sensors
- \* Systems and human health monitoring in space.

### To the nation:

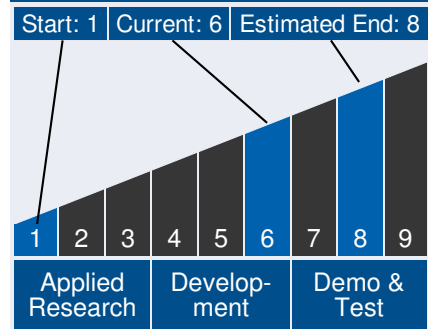
#### Commercial customers:

- Medical
- Intrusion detection
- Security, personnel and baggage inspection
- Personnel identification and access

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## Technology Maturity



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## DETAILED DESCRIPTION

### Objectives

Development of new inspection technology for quantitative evaluating integrity of wire insulation, structural components, dielectric properties, electrostatic charge (ESD), locating and characterizing hidden objects, remote monitoring and characterization of human electrochemical activities.

### Background

NDE historically has focused technology development in propagating wave phenomena, such as, X-ray, N-Ray, ultrasonic, microwave, thermal, terahertz, and eddy current with little attention to the field of electrostatics and emanating electric fields. This work is intended to bring electrostatic imaging to the forefront of new inspection technologies, and new technologies in general. The specific goals are to specify the electric potential and electric field including the electric field spatial components emanating from, to, and throughout volumes containing objects or in free space.

This work will be based on the original electric field sensor (e-Sensor) work disclosed by Generazio (2002). Current efforts have been focused on understanding the e-Sensor sensitivity and understanding the environment in which the e-Sensor is responding to.

### Customers

NASA Programs, ESD mitigation programs, astronaut health monitoring, military, public transportation safety, medical community, and computer technology developers.

### Milestones

FY16: Design 2D e-Sensor array and establish calibration protocols  
FY17: Test array for imaging electronic & structural



### Management Team

**Program Director:**

- Terrence Wilcutt

**Program Executive:**

- Brian Hughitt

**Program Managers:**

- Eric Burke
- Edward Generazio

**Project Manager:**

- Edward Generazio

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componentsFY18: Document capability of 2D array

## Project Manager

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## References

Generazio, E. R. ( November 19, 2013). Ephemeral Electric Potential and Electric Field Sensor; USTPO 61/906,068.

Generazio, E. R. (February 4, 2011). *Electric Field Quantitative Measurement System and Method*, USTPO 13/020,025 .

Generazio, E. R. (March 13, 2013). *Quasi-Static Electric Field Generator*, USTPO 13/800,379 .

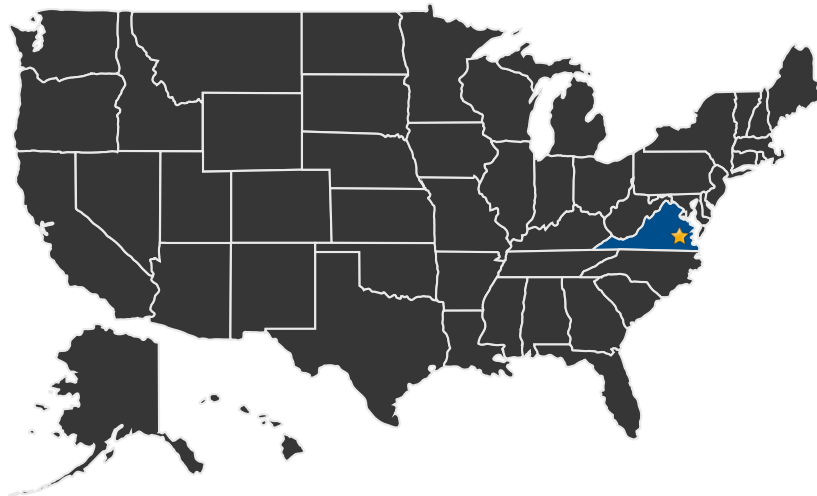
## Technology Areas

### Primary Technology Area:

Materials, Structures, Mechanical Systems and Manufacturing (TA 12)

- └ Materials (TA 12.1)
- └ Manufacturing (TA 12.4)
  - └ Nondestructive Evaluation and Sensors (TA 12.4.5)
    - └ Nondestructive Evaluation Sensor and Method (TA 12.4.5.1)

## U.S. WORK LOCATIONS AND KEY PARTNERS



■ U.S. States  
With Work

★ Lead Center:  
Langley Research Center

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## PROJECT LIBRARY

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### New Technology Reports

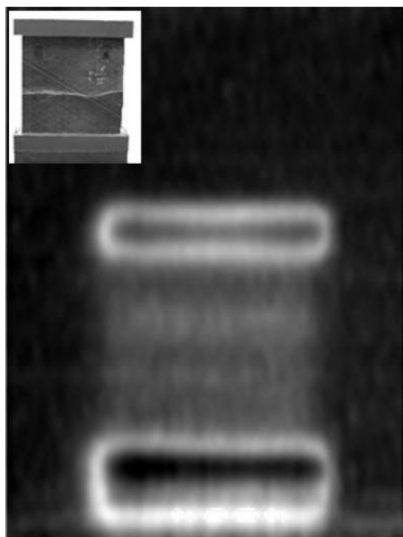
- Electric Field Quantitative Measurement System and Method. LAR 16565-1.

### Publications

- Electric Potential and Electric Field Imaging with Applications
  - ([http://nnwg.org/Recent%20Publications/Electric\\_Potential\\_and\\_Electric\\_Field\\_Imaging\\_wit](http://nnwg.org/Recent%20Publications/Electric_Potential_and_Electric_Field_Imaging_wit))
- Quasi-Static Electric Field Generator
  - (<http://www.techbriefs.com/component/content/article/1264-ntb/tech-briefs/electronics-and-computers/20952>)

## IMAGE GALLERY

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*Electric field image of a horizontally-cracked composite laminate plate tensile test specimen.*

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## DETAILS FOR TECHNOLOGY 1

### Technology Title

Electric field imaging (EFI) technology

### Technology Description

This technology is categorized as a hardware system for tools

The technology and methods for remote quantitative imaging of electrostatic potentials and electrostatic fields in and around objects and in free space are being developed. Electric field imaging (EFI) technology may be applied to characterize intrinsic or existing electric potentials and electric fields, or an externally generated electrostatic field may be used for “illuminating” volumes to be inspected with EFI. The baseline sensor technology (e-Sensor) and its construction, optional electric field generation (quasi-static generator), and current e-Sensor enhancements (ephemeral e-Sensor) are critical challenging areas being addressed. Demonstrations for structural, electronic, human, and memory applications are expected.

### Capabilities Provided

This new EFI capability will be demonstrated to remotely characterize electric charge distribution creating a new field of study, electric field imaging (EFI).

### Potential Applications

Applications included electrostatic discharge (ESD) mitigation, crime scene forensics, design and materials selection for advanced sensors, dielectric morphology of structures, inspection of containers, inspection for hidden objects, tether integrity, organic molecular memory, and medical diagnostic and treatment efficacy applications such as cardiac polarization wave propagation and electromyography imaging.

### Performance Metrics

Metric	Unit	Quantity
Demonstration of an operational, calibrated, 2D electric field sensor array for real-time EFI.	T/F	True