# Cyber Threat Targeting Critical Energy Infrastructure is Evolving: A Move From Cyber Security to Cyber Resilience is Needed

"... Countries have the capability to successfully launch a cyber-attack that could shut down the electric grid in parts of the United States" Admiral Rodgers - *NSA Director testimony to Congress, Nov. 2014*

It's only a matter of the when, not the if, you are going to see a nation state, a group or an actor engage in destructive behavior against critical infrastructure of the United States,"
Admiral Rogers, Director, NSA, US Cyber Command, CNET, March 5, 2016

Energy Security = Reliable, Affordable, Access To Energy

**Wind Farm Hack**
Tulsa U. Researchers Study Vulnerabilities of Wind Turbines

**IronGate**
Designed to target Industrial Control Systems (ICS)

**Stuxnet**
Siemens PLC (Iran)
1,000's CENTRIFUGES

**2010**
Centrifuges destroyed

**2011**
WATER UTILITY ATTACK
Pump Destroyed
(Illinois)

**2012**
HVAC SYSTEM ATTACK
(Honeywell)
(New Jersey)

**2014**
STEEL MILL ATTACK
Plant destroyed
(Germany)

**2015**
BLACKENERGY
POWER GENERATION AND DISTRIBUTION
(Ukraine)

**2016**
PLC BLASTER WORM
Targets Siemens Industrial Control Systems

**JUNE 2016**
Stuxnet Derivative Targeting ICS

**2016**
RUSSIA ATTACKS US UTILITIES

**2017**
Easy Access to Control System

**Triton**
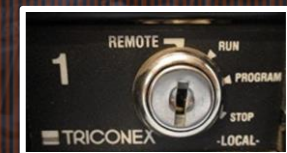
**11.2017**
Triconex Safety Control System

# Digital Ghost: An Industrial Immune System for Critical Energy Infrastructure

**Self Healing Game Changer -** Successfully demonstrated Digital Ghost's ability to - **Detect, Localize and Neutralize** advanced cyber attacks in various critical energy infrastructures and systems

**A Move from Security to Cyber Resilience** - Digital Ghost combines over 38+ innovative patents that combines artificial intelligence, cyber-physical resilience  and other advanced threat mitigation solutions

**Cyber Resilience & Optimization;** While most cybersecurity solutions increase costs and reduce functionality, Digital Ghost has the potential to improve asset performance and reduce costly faults from all **cyber-physical hazards.**



**Detect**
Human immune system Detects pathogens | Industrial immune system Detects anomalous behavior

**Locate**
Human immune system Where an attack is occurring | Industrial immune system Which sensor is being attacked

**Neutralize**
Human immune system Ability to kill pathogens | Industrial immune system Can replace a compromised sensor
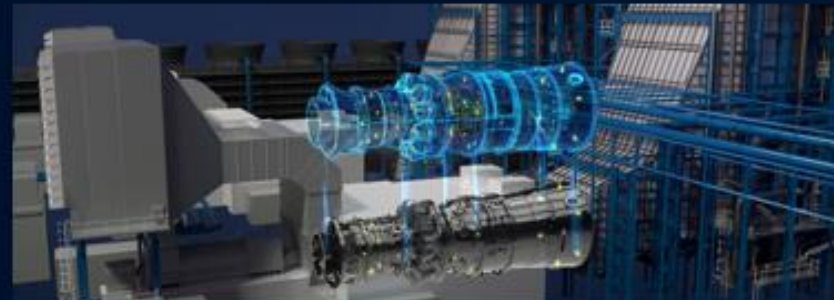
Digital Ghost uses detailed computer simulation models called Digital Twins to train sophisticated algorithms that provide Detection, Localization and Neutralization.

Physics + AI + Controls
Science + Expertise with strong 38+ Patent Filings

Digital Ghost
99% Detection Accuracy

- **Physics-based transient model** used in training DG, key for accurate predictions
- **Deep machine learning** to establish boundaries between normal and abnormal operating zones
- **Controls and Safety know-how** to maximize the accuracy of DG, ensure robust & safe operation, and enable neutralization
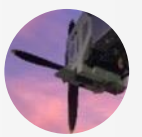
# GE Research... interdisciplinary R&D to scale

## TECHNOLOGY DOMAINS

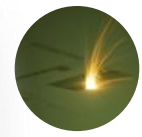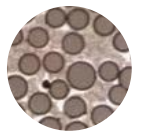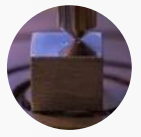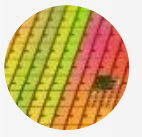- Artificial Intelligence
- Biology & Applied Physics
- Controls & Optimization
- Edge Computing
- Electronics & Sensing
- Electric Power
- Materials
- Mechanics & Design
- Robotics & Autonomous Systems
- Software & Analytics
- Thermosciences

**500+ PhDs**
*Unmatched interdisciplinary expertise*

**Research to Reality**

## PRODUCT

- 2 Cent Wind
- Next Gen Narrowbody
- Additive Machines
- Gas Turbine Leadership
- 70GWh Offshore WTG
- Plug & Play MR
- Renewable Reservoir
- Hybrid – Electric Flight

## HORIZONTAL

- Additive
- Artificial Intelligence
- CMC
- Controls/ Secure Edge
- Service Technology
- Digital Twin & Cyber
- Specialty Materials
- SiC

## EXPONENTIAL

- Autonomous Imaging
- Bioelectronic Medicine
- Industrialized Blockch
- 3rd Wave AI
- Quantum Sensing & Computing
- Trusted Autonomy

**A unique competitive advantage for GE**