DETECT, MONITOR, REACT

PRACTICAL APPLICATIONS OF UNMANNED AERIAL SYSTEMS IN GEOHAZARD RISK MITIGATION

HAZON SOLUTIONS

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Unmanned Systems at Work

END-TO-END UAS COMPANY

- History and mission
- Services
  - Critical infrastructure inspections
  - Crisis response
- Training
- Software




UAS LIMITATIONS

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REGULATORY

- Beyond visual line of sight
- Night flight

TECHNOLOGY

- Automation
- LIDAR
- 3D photogrammetry
- Observation only

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HAZARD IDENTIFICATION

- Detection involves periodic collection of data in at risk environments analyzed relative to specific hazard thresholds
  - Data collection
  - Data analysis
  - Comparison to hazard thresholds
- Implied requirement:
  - Hazard criteria must be defined clearly or assessed by a subject matter expert
- UAS advantages
  - Unique vantage points and angles, safety of personnel

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HAZARD IDENTIFICATION

- Targets for detection
  - Landslide / rockfall
    - Slope angle, slope loading, volumetric measurement
  - Debris flow barriers
  - Rock netting / drapery
  - Symptoms of subterranean or manmade geohazards
    - Sinkholes
    - Improperly installed fill / foundation

DETECT

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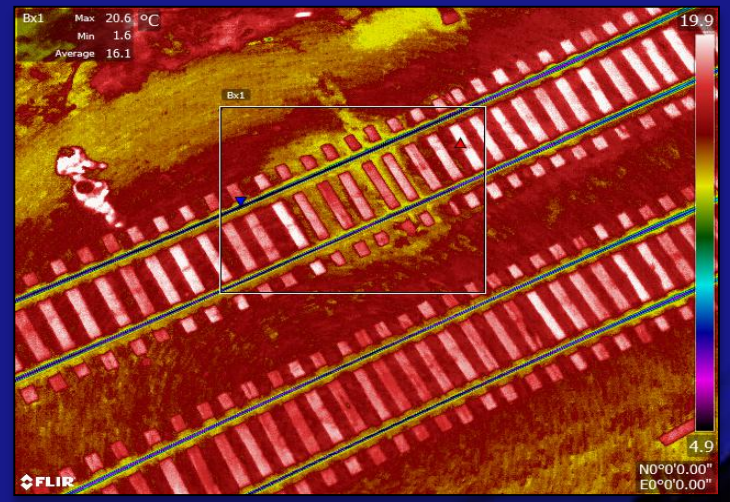
TECHNIQUES

- High mega-pixel still frame or HD (4k) video
- Infrared still frames or video
  - Subsurface water identification (rail ballast)
- 3D mapping
  - Interactive 3D maps
  - Contour line maps
  - Volumetric measurement
- Most useful when periodically repeated
  - Provides context which amplifies data



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MONITORING POTENTIAL GEOHAZARDS

- Differs from detection in that a risk has been identified and assessed
- Techniques remain the same, frequency of observation increases relative to risk level
- Risk is measured in
  - Likelihood of realization
  - Severity relative to safety
  - Severity relative to throughput (operational risk)

MONITOR

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Likelihood	Description
A	Likely to occur, immediately or within a short period of time.
B	Probably will occur in time.
C	May occur in time.
D	Unlikely to occur, but not impossible.
Severity	**Description**
I	Complete closure. Death or permanent total disability. Loss of a critical system or equipment. Major facility damage. Severe environmental damage.
II	Significantly degraded throughput. Severe injury. Extensive damage to equipment or systems. Significant damage to property or the environment.
III	Decreased throughput. Minor damage to equipment. Minor injury or illness.
IV	Little impact on throughput. Minimal threat to safety. Slight equipment or systems damage.

MONITOR

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Risk Likelihood	RISK SEVERITY			
	I	II	III	IV
A	EXTREME	HIGH	MEDIUM	MEDIUM
B	HIGH	MEDIUM	MEDIUM	LOW
C	MEDIUM	MEDIUM	LOW	LOW
D	LOW	LOW	LOW	NEGLIGIBLE

MONITOR

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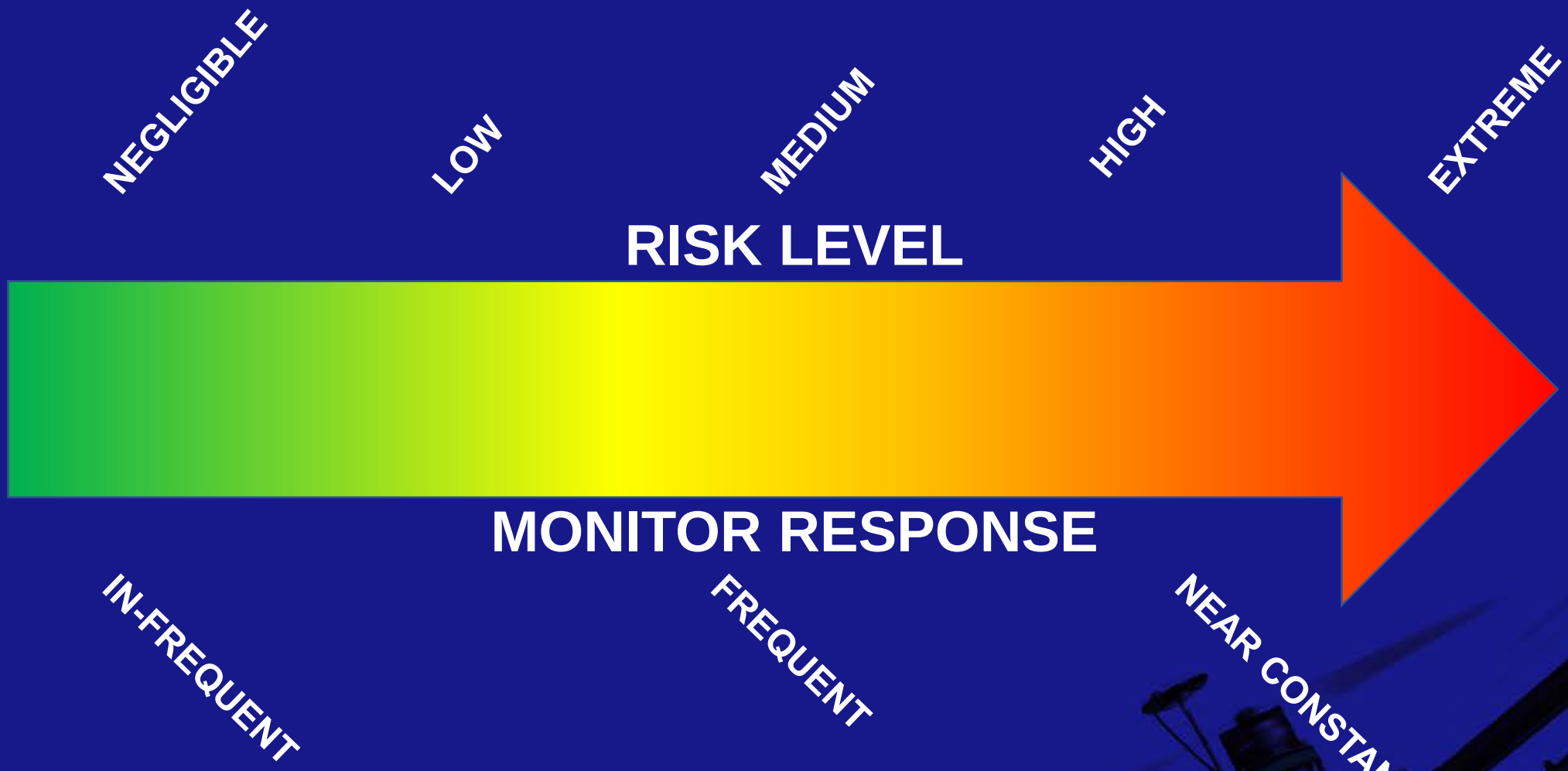

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UAS IN CRISIS RESPONSE

- Techniques
  - Safety assessment for first responders and on-scene engineers
  - Direct observation
    - High megapixel still frames
    - HD (4k) video
    - Live streaming to key stakeholders / decision makers
  - 3D mapping
    - Volumetric measurement of debris

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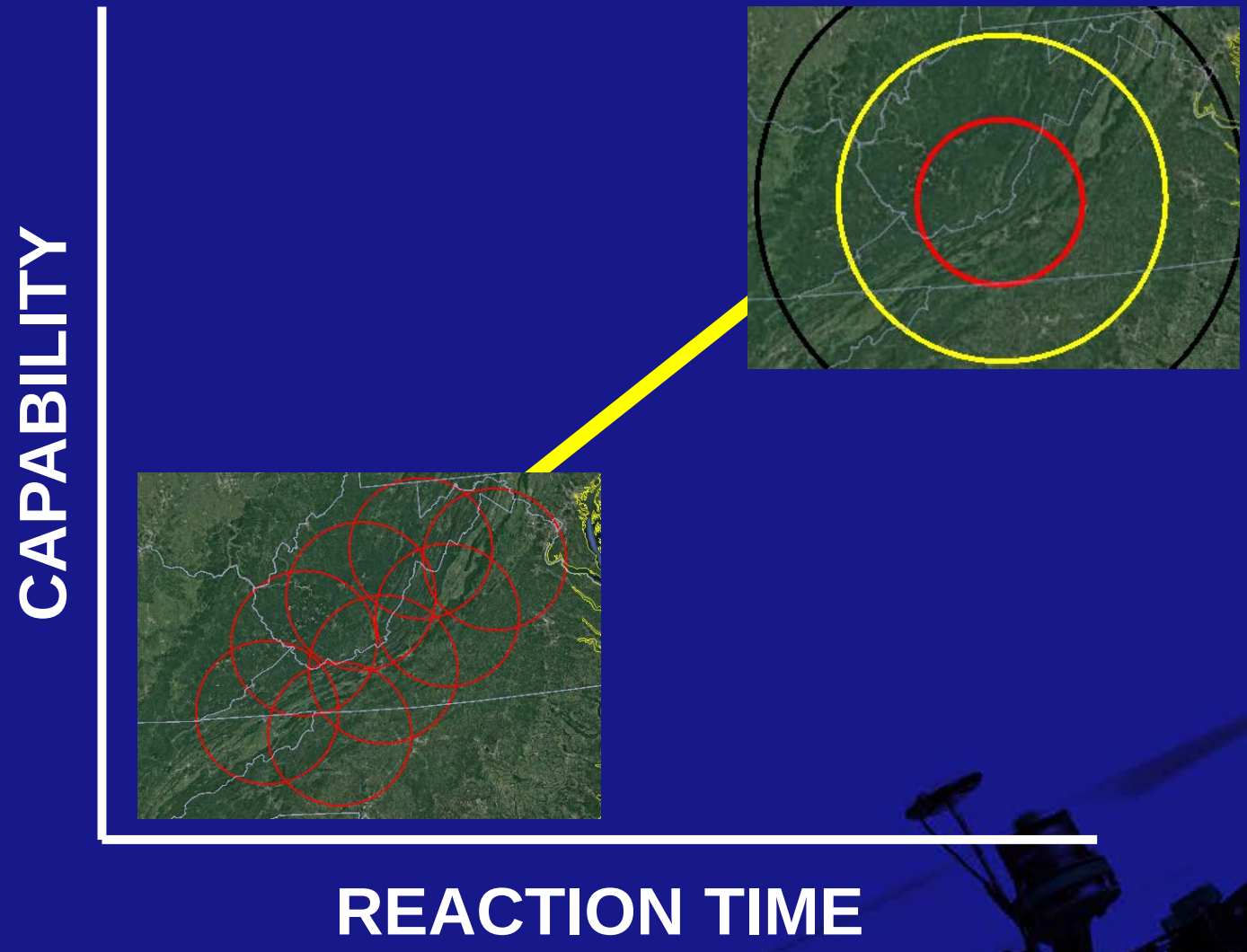
CAPABILITY VS REACTION TIME

- Increased capability is likely directly proportional to reaction time
  - More sophisticated techniques (live streaming / 3D mapping) requires
    - Increased training and equipment
    - Generally associated with low density / centralized assets and personnel
  - Less sophisticated capability (direct observation tools)
    - Can be widely distributed / high density

REACT



WAY FORWARD

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INTEGRATING UAS INTO YOUR ORGANIZATION

- Define requirements
  - High density / low capability vs low density / high capability
  - Mixture
  - Outsourcing
- Develop program structure (internal leadership)
- Source equipment and training
  - FAA Part 107 training
  - Hands-on flight training
- Monitor flight operations, recurrent training, results

CONTACT INFO

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