

Team Members:

Michael McNinch - PI

Samir Sbai – Co PI

Carl Sunderman

Dave Koski

Dan Terzi

Bob Bissonette

Machine Situational Awareness

Automation and Emerging
Technologies Team

Precursor Work

Conveyor Safety Project

Recognition that there was only so much that humans could do to improve safety around potentially hazardous equipment. The equipment itself would need to play a more active role (in contrast to passive) in preventing hazardous conditions.

AASIST Project (Assured Autonomy Safety Intervention System Technology)

Development of an approach to autonomy that was validatable, predictable, repeatable, flexible, and applicable to virtually all autonomous and highly automated equipment (stationary, mobile, and hybrid).



ISO 17757

Earth-moving machinery and mining — Autonomous and semi-autonomous machine system safety -

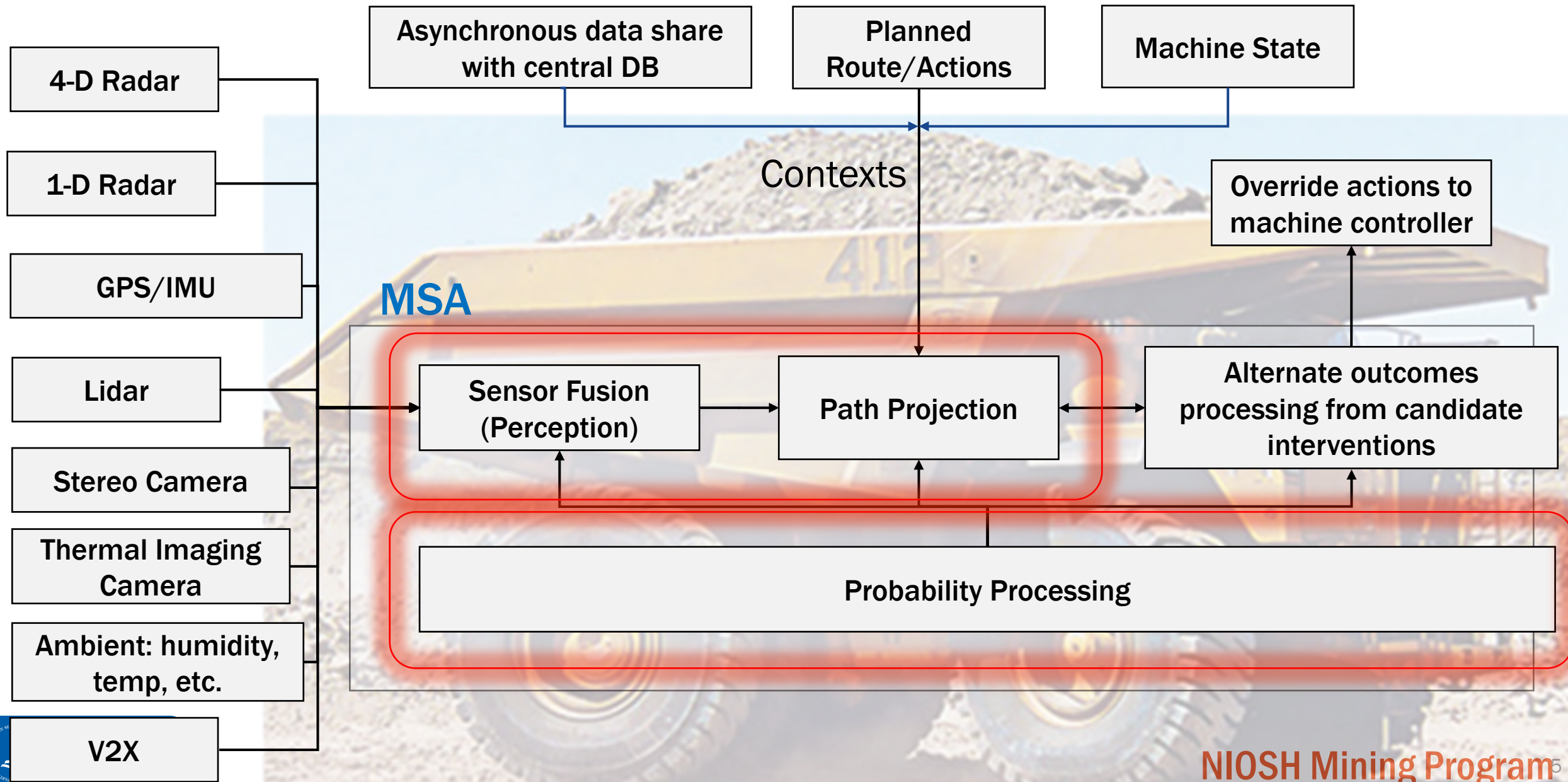
- Transition from manual to semi-autonomous (remote operation, etc.) requires situational awareness to transfer from human operators to machines.
- Command structure is clear; safety structure is not.
- Implication and logical conclusion is that safety control should be a parallel system with primary function of intervention.
- Ultimately, there will be an ISO extension that lays out a framework and validation scheme.

Short Term Approach

Lit review

1. Determine if there is an existing framework that would translate to this industry.
2. Identify methods, mathematics, and algorithms appropriate for mobile and stationary equipment.
3. Work with OEMs, retrofitters, engineering and mine operations to develop research.

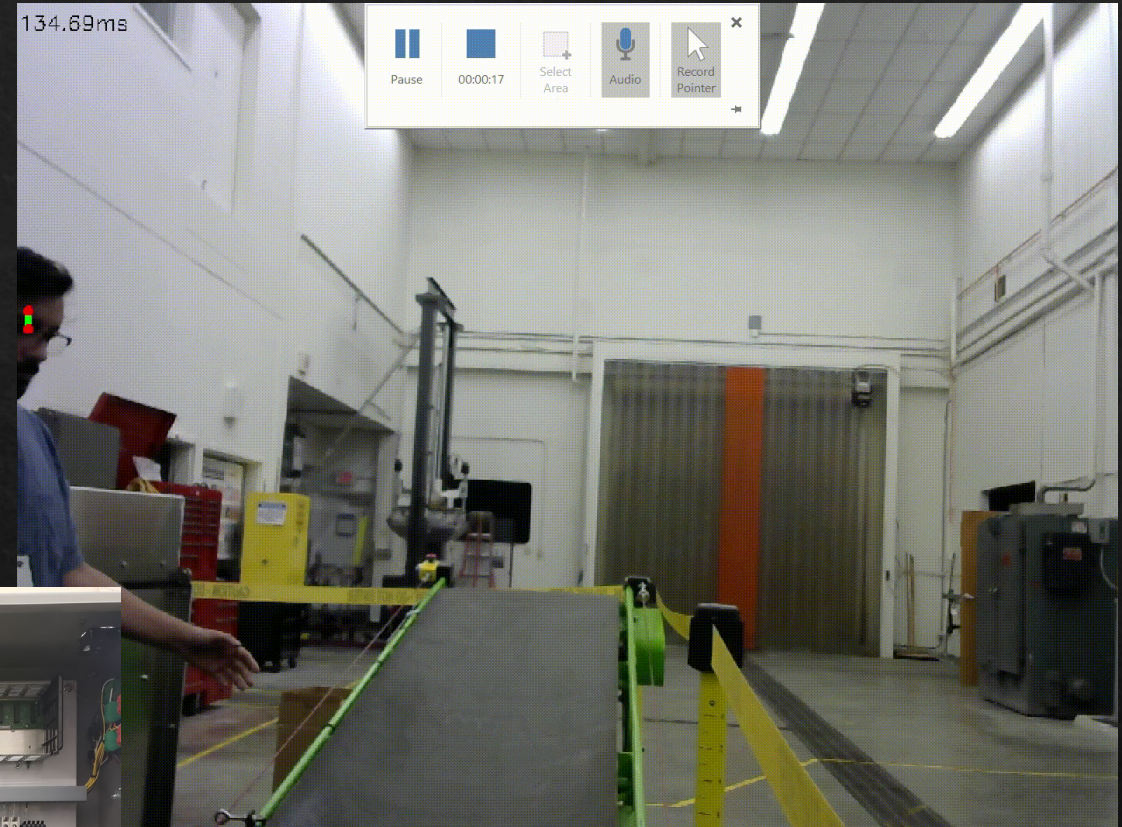
Assured Autonomy Safety Intervention System



Preliminary Test Facilities



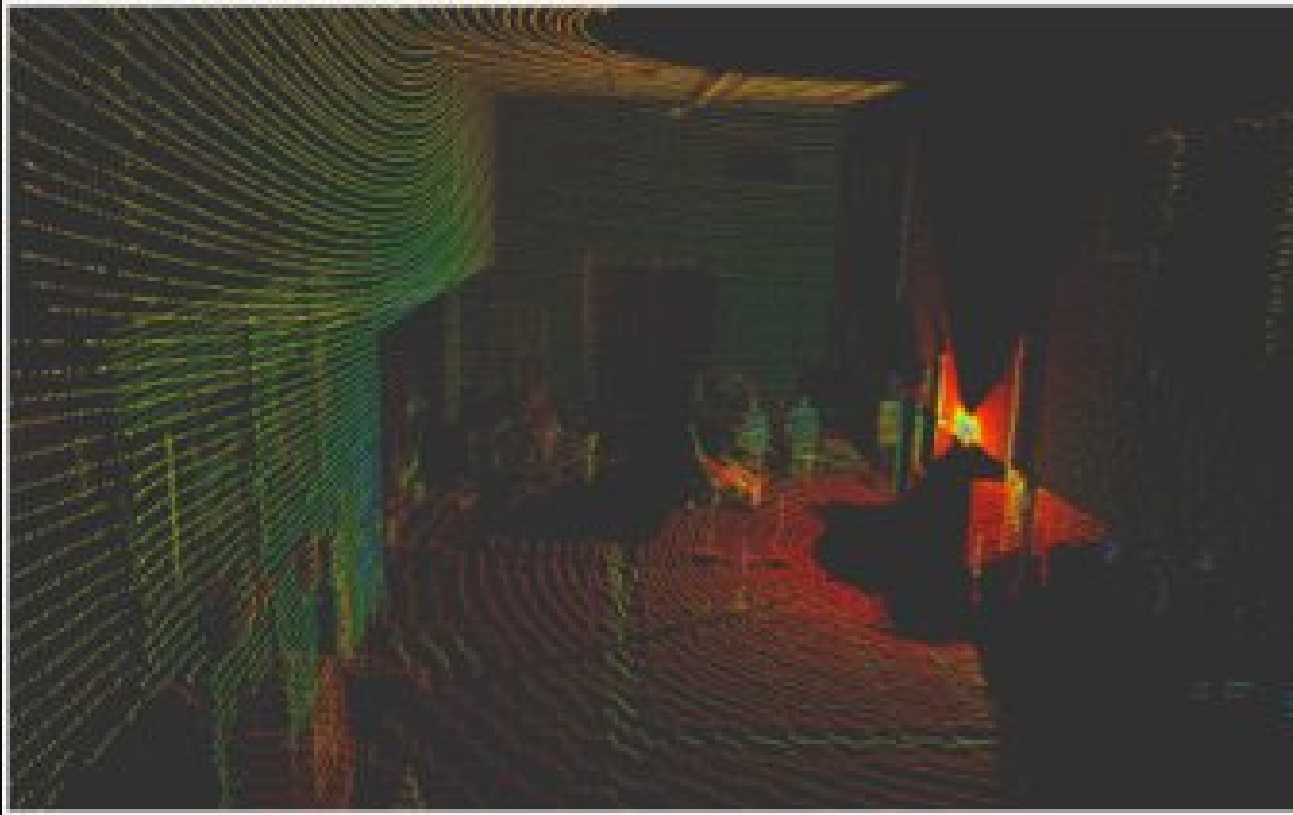
Machine Safety Lab



Skeletal Tracking System



Preliminary Testing



LIDAR



Thermal Camera

State of the Industry

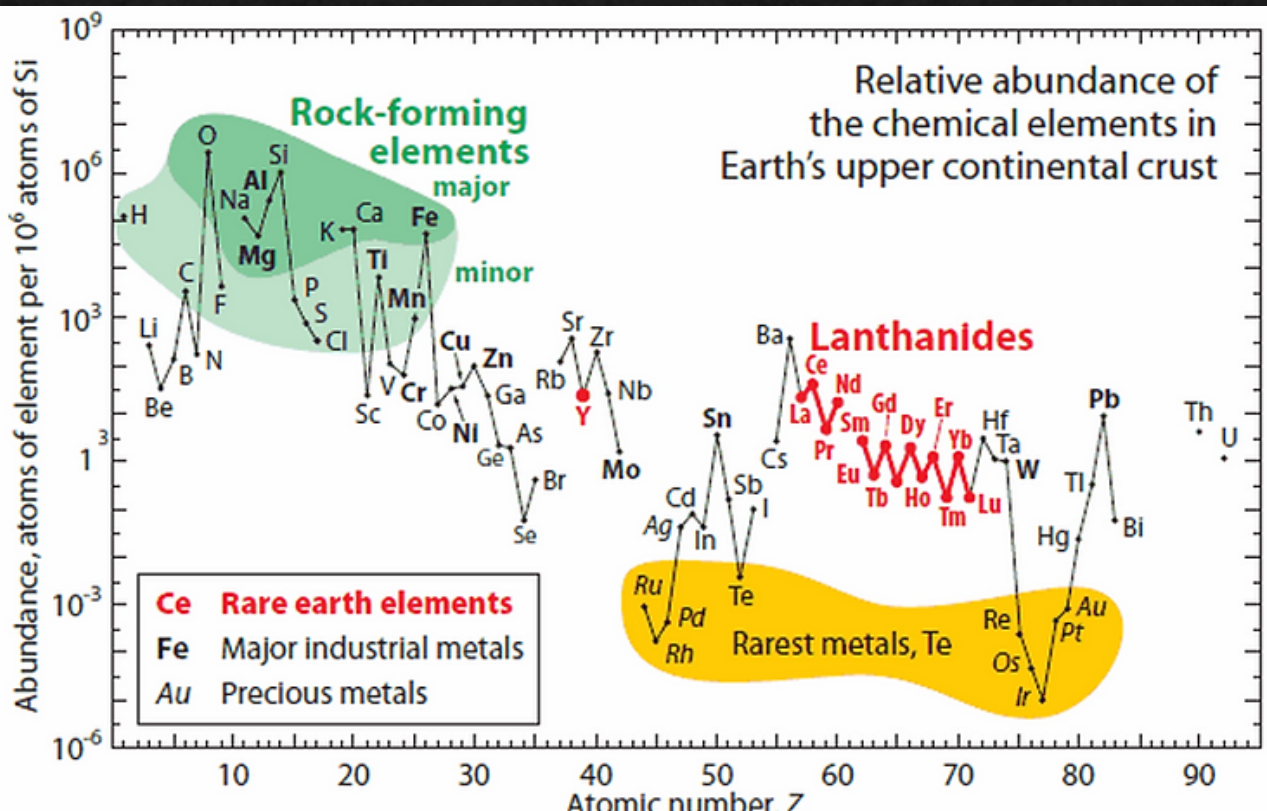
Our timing is right

- 1) Attempts at full autonomy have been fraught with setbacks (not just mining). Most use classic predetermined risk analysis.
- 2) Our approach is novel and deterministic. There is an instinctual aversion to Artificial Intelligence and Machine Learning where critical systems and liability are concerned.
- 3) Every factor is pointing to the need to get Assured Autonomy implemented successfully.
 - a) Geo-politics
 - b) Push for de-carbonization
 - c) Population collapse (specifically working aged people)
 - d) Ever increasing sensitivity to safety
- 4) Industry players (Operators, OEMs, etc.) are looking for a solution.



Simple Facts:

- Mining in US will become critical to environmental and economic preservation.
- Geopolitics are becoming complicated, and not improving soon.
- We will have to go deeper and extract from technically difficult deposits to maintain supply.
- We can't wait for BNI (Burden, Need and Impact) to address challenges and opportunities.





Resulting Future Realities:

- Fiscal reality will force the mining industry to take full advantage of automaton and autonomy.
- New mining environments would be exceptionally dangerous for traditional mining and miners.
- For the foreseeable future, autonomous equipment will need to be repaired and maintained by humans.

Questions?

Presented by – Bob Bissonette
Automation and Emerging Technology Team Lead

Contact us @ gnq8@cdc.gov if you have questions,
concerns or critique.



NIOSH Mining Program