



IRONPIPE Interoperable Resilient Operations Network for Proficient IoT Performance and Efficiency

AI Technology Impact Forum

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- Aptima Introduction
- Overview of IRONPIPE
- Live Demonstration
 - IoT Sensing Capabilities
 - Generative AI Reporting
- Question & Answer



The Aptima Approach

- Understand the human user *equally well* with understanding of the technology
- Scientific *innovation* paired with disciplined Agile engineering practices
- Analyze and design complex sociotechnical systems that *serve a mission purpose*

Results of our Work

- Empower Human-AI teams
- Accelerate human learning
- Transform the work of the future





About Aptima

Artificial Intelligence Technologies

Transforms and applies advanced AI/ML technologies, including generative language models, time series forecasting and classification, adaptive planning, and explainable models, to enable novel insights across domains

Sensor-Based Assessment Technologies

Utilizes signals from the human to provide awareness of and evaluate current states and skills and abilities to guide decision making and inform interventions in both training and real-world contexts

• Human Machine Team Design & Evaluation Facilitates the formation, sustainment, and evaluation of augmented human-machine teams through novel design considerations, test and evaluation frameworks, collaboration technologies, and advanced analytics





• Master Command and Control for Multiple Activity Visibility:

- Depots and distributed maintenance workers lack a common operating picture or common process guide to conduct operations and receive real-time feedback on efforts
- DON seeks a way to track naval depot maintenance capacity and specialties enterprise-wide to optimize resource allocation.





IRONPIPE Overview





• Internet of Things (IoT) powered platform

- Distributed sensor network linked to AWS GovCloud services
- Real-time monitoring and coordination between:
 - Fixed assets
 - Mobile assets
 - Facilities
 - Personnel

Common Operating Picture provides central insight for

- Increased situational awareness
- Reduced access times for critical tasks
- Improved decision making and coordination, e.g., equipment usage and repairs



IRONPIPE High-level Architecture





IRONPIPE Sample Sensors

Personnel Safety







))

Location Tracking

Environmental Conditions



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IRONPIPE: Asset/Person View

RONPIPE									
bjects	+ ADD SUBJECT	0 Active Alerts							
nsors	💛 TacDIVE1								
erts	TacDIVE2	TacDIVE2 : Sensors (**) PAIR							
nulator	TacDIVE3	ID dcf667ca-04e9-41a7-b638-f23b03a58c38 TacDIVE Sensor 2 ×							
stem		Created 10:24, 22 Jul 2024							
		Latest State C REFRESH							
		Live Data							
		Features HEART_RATE ↓ HEART_RATE ↓							
		⁸¹ ⁷⁸ ⁷⁵ ⁷² ⁶⁹ ^{10:27:24} ^{10:27:39} ^{10:27:54} ^{10:28:09} ^{10:28:24}							

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APTIMA[®] Human-Centered Engineering[®]

IRONPIPE: Alerting Demo View

(+) 1 Active Sim

IRONPIPE						IRONPIPE					
Subjects Sensors Alerts	+ ADD SUBJECT TacDIVE1 TacDIVE2	 1 Active Alert High Heart Rate Detect 10.26:51, 22. Jul 2024 Heart Brite in physic 90 		^ ×	Subjects Sensors Alerts Simulator	ALERTS RULES SUBSCRIPTIONS Subscriber ID IRONPIPE					
Simulator System	TacDIVE3	TacDIVE1	Sensors TacDIVE Sensor 1		(**) PAIR ~	System	Occurred At 10 26, 22 Jul 2024	Subject	Seventy	Title High Heart Rate Detect	Di
		Latest State HEART_RATE 71		C 10:29, 2	REFRESH 22 Jul 2024						
		Live Data Features Select a Feature to view data			\$						
						▲ 1 Active Alert					

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Actions

rt Rate is above 90



IRONPIPE: Sensor Configuration

IRONPIPE						
Subjects	ADD SENSOR					
Sensors	PAIRED UNPAIRED	Subject -				III COLUMNS 🚍 DENSITY 🛃 EXPORT
Alerts	ID	Created At	Name	Subject	Actions	
System	04:8A:04:92:4A:22	10:25, 22 Jul 2024	TacDIVE Sensor 1	TacDIVE1	/	
	DF:2E:1F:AE:98:55	10:25, 22 Jul 2024	TacDIVE Sensor 2	TacDIVE2	/ 🗊	
	F1:7E:A9:A2:AD:6E	10:26, 22 Jul 2024	TacDIVE Sensor 3	TacDIVE3	/ 1	



- Generative AI adds a new layer of data utilization to IRONPIPE
- Automated data analytics
 - Retrieve data and identify meaningful patterns/trends
- Report generation
 - Provide convenient reports/notifications to key organizational leaders

Welcome	Chat	Search	RAG	Summarize	Documents	Queries	Experin	nental	Settings			
History												•
Question										Model ID		
How many machine alerts happened in the past month?								azure-gpt-4 🗸	Ask			
Query	Query #Documents							ents				
Retrieved N	lodes											•
	Save Response as Content											

Use Case: Improve Efficiencies

IRONPIPE + Asset Tracking/Location

- Inventory Updates Automatically
- Location is accurate and traceable
- Inventories for:
 - Parts

Human-Centered Engineering®

- Materials
- Tools

• Outcomes:

- Reduce time/effort locating items
- Automated alerts for low inventories
- Tracking of parts to specific production line items
- Flexibility to reduce time/effort to complete tasks:
 - Two upgrades in progress:
 - Pulling a single part will complete one

Bottom Line

Situational Awareness of inventory allows for reducing time/effort while supporting flexible, agile, and accurate decision making to increase production.



Use Case: Machine Health Monitoring

Assumptions for MHS Use Case

- Pressure Sensor
- Temperature Sensor
- Vibration Sensor
- Machine Status
- Sensor Indicators :
 - Filters have known nominal pressures
 - Running Temperatures are known
 - Nominal Vibrations are known
 - Status: Running, Ready, Down, etc.

- IRONPIPE Alerting
 - Alerts are generated for deviations from normal operating conditions to
 - Provide data for decision to:
 - Halt Production
 - Automate High Priority Repair Request
 - Reduce Production
 - Automate Medium Priority Repair Request
 - Continue Production
 - Automate Low Priority Repair Request
 - Data can be associated with assets' maintenance and purchase history.

Bottom Line

Data is available for decisions on asset being monitored. Aggregation of information informs overall production capabilities.



Use Case: Automated Auditing

- Assumptions
 - 100 Assets
 - 5 minutes / asset to locate
 - Quarterly Audits
- Estimates for Manual Audit:
 - ~ 8 hours per Qtr.
 - + time for Report/Forms Prep
 - ~ 10 hours / Qtr
 - Total: ~ 40 hours / year

- IRONPIPE + Asset Tracking/Location
 - Inventory Updates Automatically
 - < 5 minutes for Report/Forms Prep</p>
 - < 1 hour for 10% manual locating</p>
 - ~ 1 hour / Qtr
 - Total ~ 4 hours / year

Bottom Line

10x Reduction in time for Auditing of Assets

Benefits: Reduce/Eliminate Manual Errors + Alerting for Missing Assets



Q&A Time



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