711th Human Performance Wing

Integrity ★ Service ★ Excellence

Developing an Autonomous Task Manager for Intelligence, Surveillance, and Reconnaissance Human-Machine Teams

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Current Analysts' Challenges Within ISR Environment

- Workload consists of multiple tasks and long shifts
- Work within Human-Machine Teams (HMT) to Process, Exploitation and Dissemination (PED) Essential Elements of Information (EEIs) to customer down range
- Multitasking environment may require automation to improve overall performance (accuracy and efficiency)
  - Reduce repetitive "busy work"

    Examples:

    Copy & Pasting

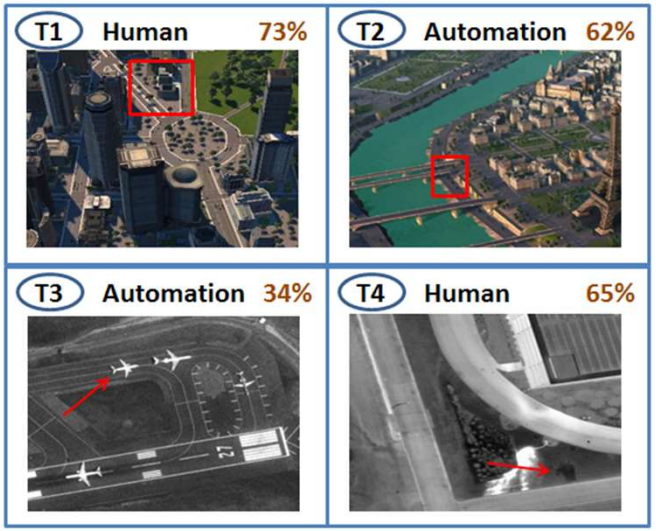
    Target Detection

Initial Autonomous Manager (AM)

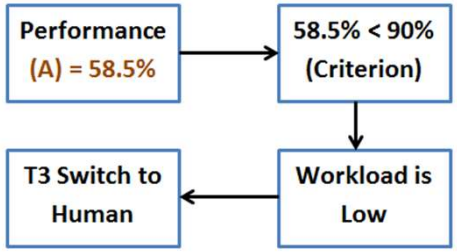
Autonomous Manager (AM) is a "new agent" within the PED cell. Through simulation, AM currently:

- *Intelligently* and *dynamically* parses task allocation in real-time based on agent performance and workload
- Simulates performance with varying prior uncertainty
- Incorporates physiological indicators of human workload (e.g. heart rate)

(a)

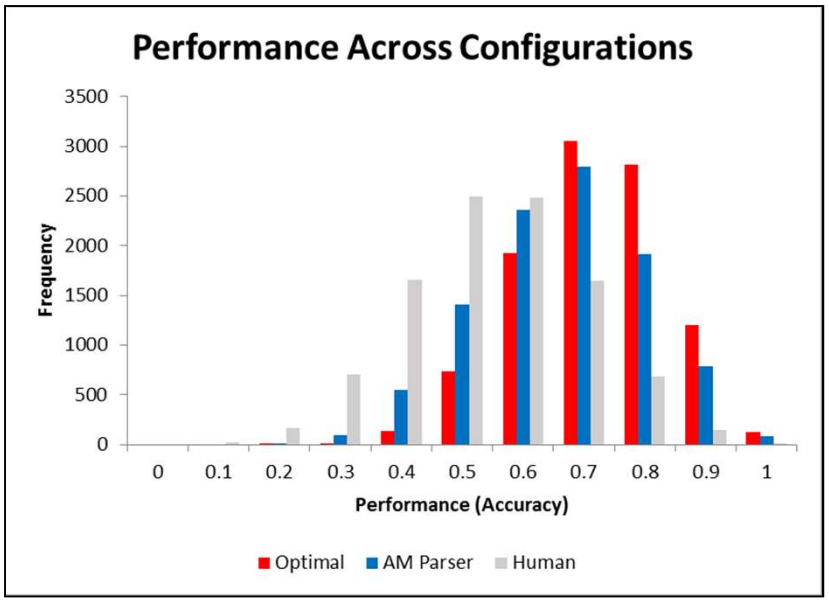


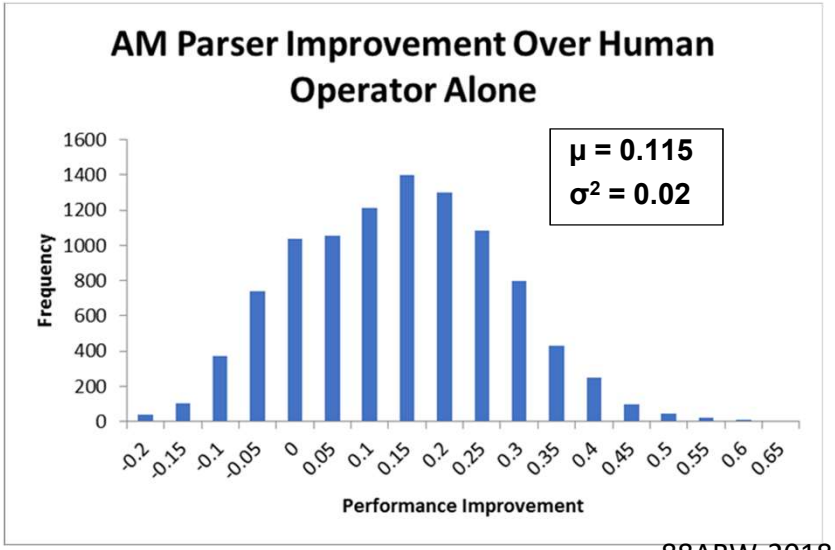
(b)



(a) Multi-INT dashboard of four tasks (e.g. T1, T2, T3 and T4)
(b) Example of task allocation based on performance criteria and workload

AM Simulation Performance





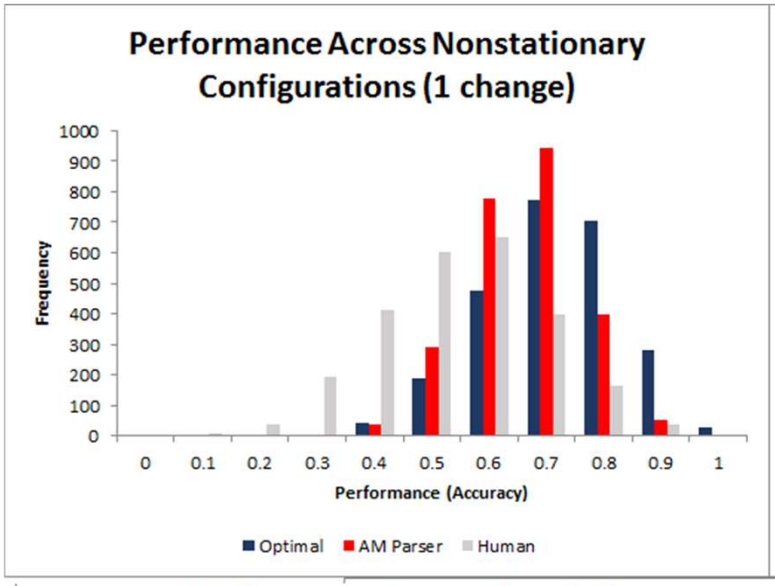
Mean Performance

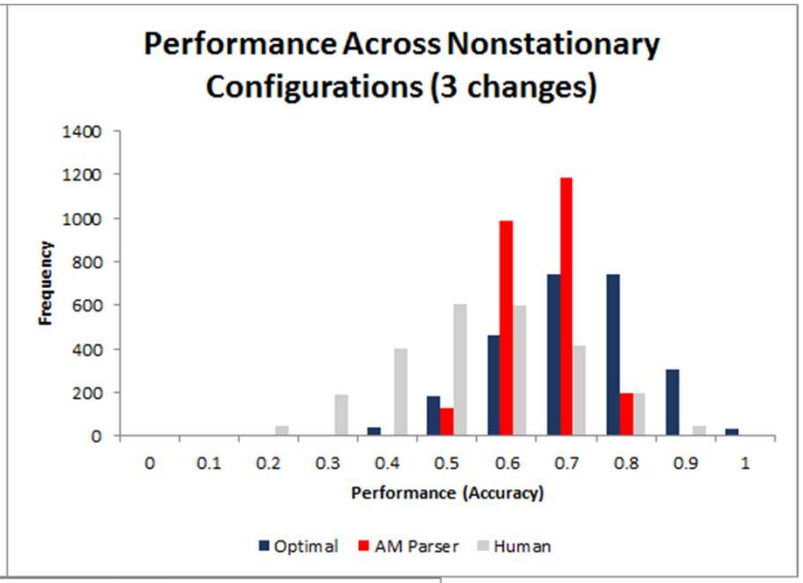
- AM Parser performs 11.37% better than Human baseline
- Optimal Performance performs 5.46% better than AM Parser

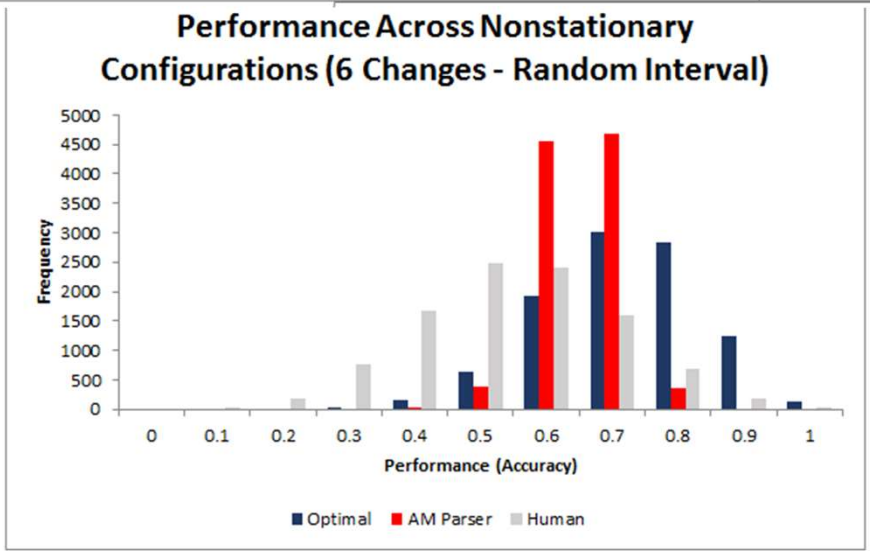
Performance Improvement (Δ)

Under which task conditions do we find greatest and lowest degree of improvement

AM with Nonstationary Performance



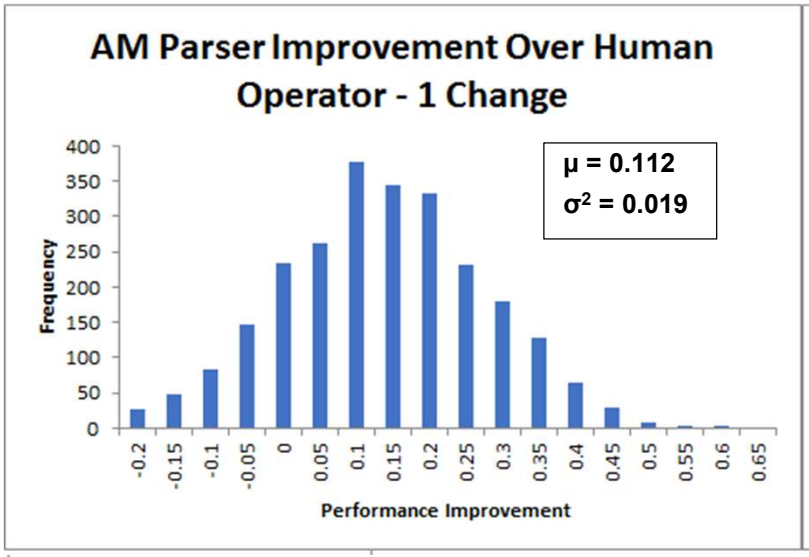


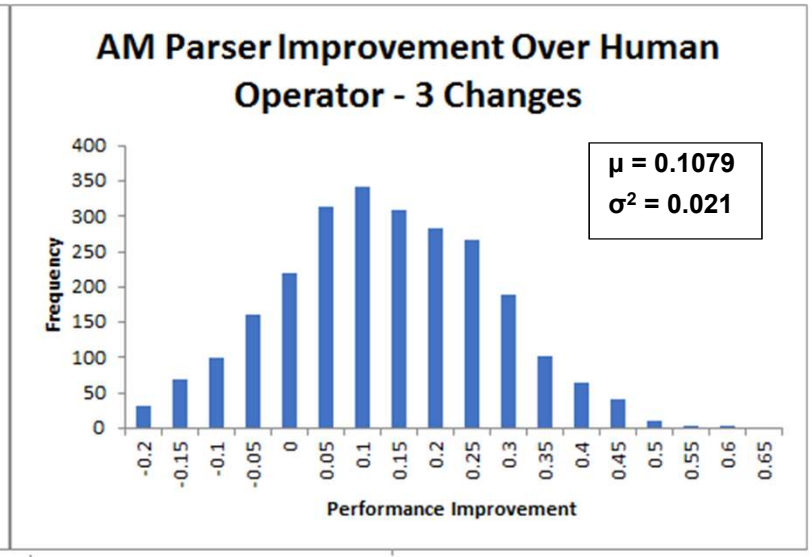


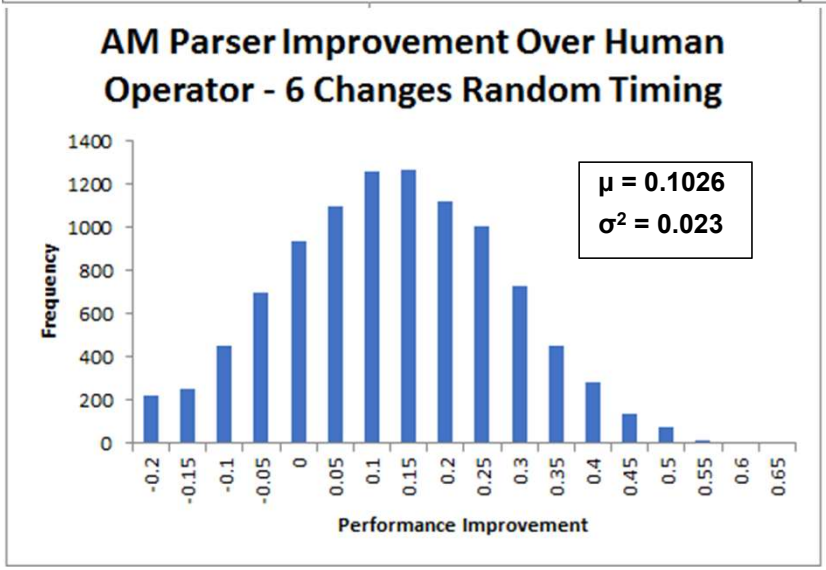
Mean Performance of Optimal and AM Parser

- Stationary: 5.46%
- Nonstationary (1 change): 5.52%
- Nonstationary (3 changes) : 6.12%
- Nonstationary (6 changes) : 7.03%

Nonstationary Performance







Performance Improvement (Δ)

- Stationary: 11.37%
- Nonstationary (1 change): 11.20%
- Nonstationary (3 changes) : 10.79%
- Nonstationary (6 changes) : 10.57%

Conclusions

- Initial simulation shows:
  - Performance improvement
  - Robust to dynamically changing performance conditions
  - Can be improved with more sophisticated models of workload and more flexible performance thresholds

Future Work

- Add more physiological indicators of human workload
- Extend AM beyond static thresholds
  - Physiological & Performance
- Model hierarchical dependences between tasks
  - Single HMT, Teams of HMTS
- Develop task environment
  - Modify AM to real-time parsing of physiological and performance

Questions?

Nonstationary Mean Performance

Nonstationary Summary Statistics						
Condition	Optimal Mean (SD)	AM Parser (SD)	Mean Difference	t	p	Effect Size
Nonstationary (1 Change)	66.81% (11.92%)	61.29% (9.45%)	5.52%	58.16	0.000	0.513
Nonstationary (3 Change)	66.97% (11.99%)	60.85% (6.64%)	6.12%	56.07	0.000	0.631
Nonstationary (6 Change)	67.04% (11.91%)	60.01% (5.63%)	7.03%	57.19	0.000	0.755
Condition	Optimal Mean (SD)	AM Parser (SD)	Mean Difference	t	p	Effect Size
Nonstationary (1 Change)	50.09% (14.53%)	61.29% (9.45%)	11.20%	80.67	0.000	0.914
Nonstationary (3 Change)	50.06% (14.62%)	60.85% (6.64%)	10.79%	74.59	0.000	0.948
Nonstationary (6 Change)	49.75% (14.77%)	60.01% (5.63%)	10.26%	67.63	0.000	0.918