

SAM 3.0 Workshop

Alliance SV Lab

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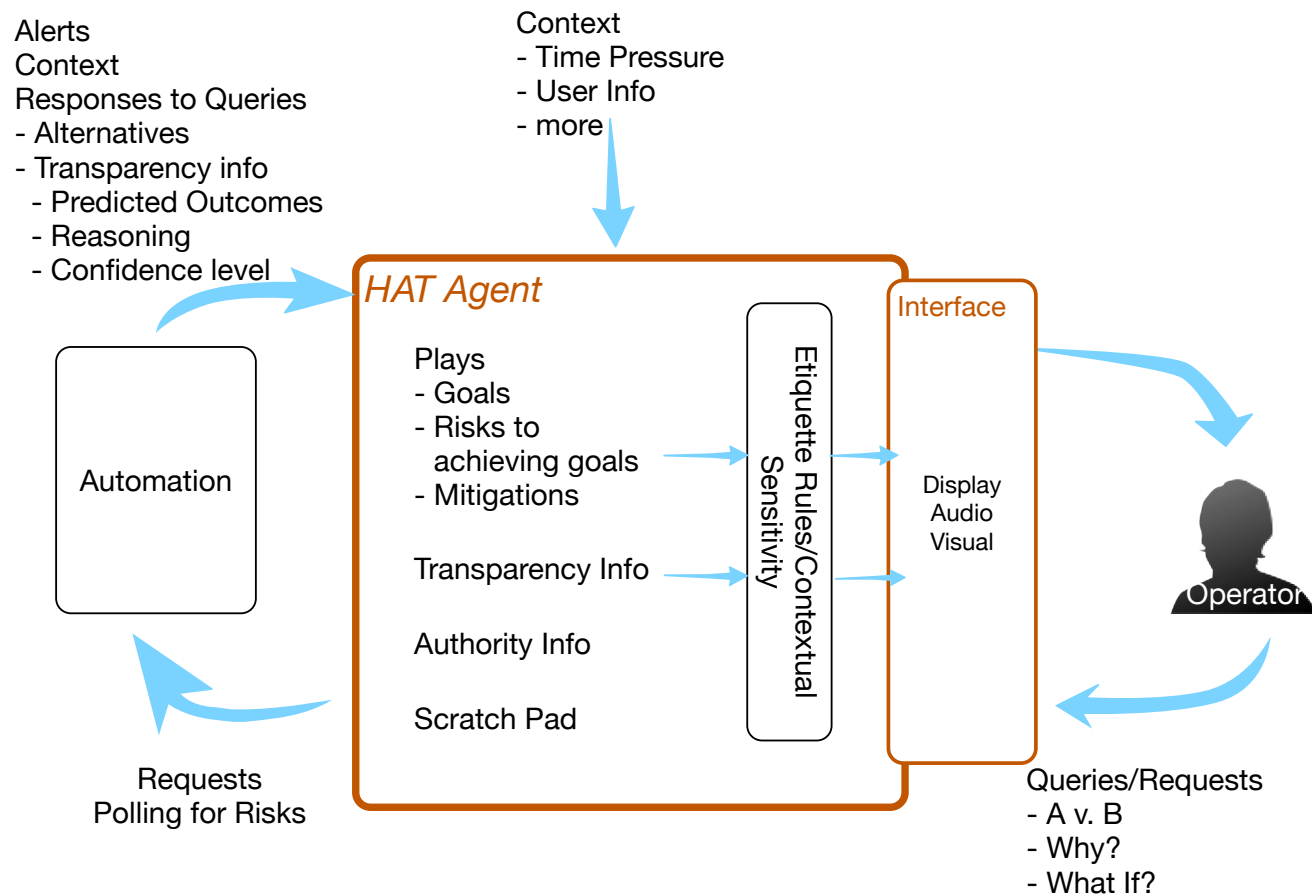
HAT lab team

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Problems with Automation

- Brittle
 - Automation often operates well for a range of situations but requires human intervention to handle boundary conditions (Woods & Cook, 2006)
- Opaque
 - Automation interfaces often do not facilitate understanding or tracking of the system (Lyons, 2013)
- Miscalibrated Trust
 - Disuse and misuse of automation have lead to real-world mishaps and tragedies (Lee & See, 2004; Lyons & Stokes, 2012)
- Out-of-the-Loop Loss of Situation Awareness
 - Trade-off: automation helps manual performance and workload but recovering from automation failure is often worse (Endsley, 2016; Onnasch, Wickens, Li, Manzey, 2014)

HAT Model



HAT Solutions to Problems with Automation

- Brittle
 - **Negotiated decisions** puts a layer of human flexibility into system behavior
- Opaque
 - Requires that systems be designed to be **transparent**, present **rationale** and **confidence**
 - Communication should be in terms the operator can easily understand (**shared language**)
- Miscalibrated Trust
 - Automation **display of rationale** helps human operator know when to trust it
- Out-of-the-Loop Loss of Situation Awareness
 - **User directed interface**; adaptable, not adaptive automation
 - Greater interaction (e.g., **negotiation**) with automation reduces likelihood of being out of the loop

HAT Agent

- Mediates human interaction with autonomy
 - Transparent
 - Pilot Directed
 - Comm Channel
- Working agreements
 - Transition to automation
- Applied to single pilot ops/Dispatch

Delegation Control: Playbook[®]

- Delegation: one way humans manage supervisory control with heterogeneous, intelligent assets
- Playbook[®] : one means of delegation
- Plays: analogous to football
 - Quick commands – complex actions
- A Play provides a framework
 - References an acceptable range of plan/behavior alternatives
 - Requires shared knowledge of domain Goals, Tasks and Actions
 - Supervisor can further constrain/stipulate
- Potentially facilitates intuitive cooperative control of Unmanned Systems

Potential Concepts

- Playbook
- Bi-directional communication
- Transparency
- Operator directed interface

Use Case Questions

- What is the human's task?
- What information is required?
 - Temporal component
- What is (is there) the optimal solution?
- How do humans solve this problem?
- What are the metrics?
 - Time
 - Risk
- How best to display?

HAT and Contingency Management in a Flight Following Context

Initial Reduced Crew Operations (RCO) Research Efforts

- Motivation
 - Enable commercial transports to fly with only one pilot to **save money** and **address a potential pilot shortage**
- Possible Approaches to RCO
 - Support from flight deck automation
 - **Remote support from a human operated ground station**
 - Remote support from a human operated ground station and flight deck automation
- Goals and Objectives
 - Develop and evaluate advanced flight deck- and ground-based technologies and concepts utilizing
 - Unmanned Aircraft Systems (UAS) technologies
 - New air-ground datalink capabilities
 - Intelligent agents located on flight decks and at ground stations

RCO CM Flight Following Context

- Ground support of pilots under reduced crew operations
 - Looking primarily at flight following/re-routing
 - ConOps: automation does more flight planning; dispatchers aided by automation and real time information do more tactical decision-making
- Alerted when
 - They go off path or fail to comply with clearances
 - Significant weather events affect their trajectory
 - They fail to act on EICAS alerts
- Rerouted aircraft when
 - Weather impacts their route
 - System failures or medical events force diversions

Ground Station Layout



Plays/Working Agreements

The screenshot displays the R-HATT Play Manager interface. At the top, the 'Active Plays' section shows a list of plays, including 'Airport Closure' (NASA04), 'NASA106', 'NASA114', 'NASA139', 'NASA147', and 'NASA165'. The 'Play Node Graph' section shows a visual representation of the 'Airport Closure' play's structure, including nodes for 'Find Delayed Aircraft', 'Develop Delay Options', 'Analyze Delay Routes', 'Develop Route Options', 'Analyze Routes', and 'Uplink'. The bottom section provides a detailed view of the 'Airport Closure' play, including a checklist of tasks, route recommendations, and a risk assessment.

Active Plays

Play	Status	Attention
1 Airport Closure	⚠️	

Actions

Time	Status	Play	Action
Just now	⚠️	NASA139	Manual route entry required
Just now	⚠️	NASA165	Manual route entry required
Just now	⚠️	NASA106	Route waiting approval S: KDEN
Just now	✅	NASA147	Executing new route soon: S: KDEN
Just now	✅	NASA04	Executing new route soon: KCOS

Play Node Graph

The graph shows the flow of the 'Airport Closure' play, starting from 'Find Delayed Aircraft' and proceeding through 'Develop Delay Options', 'Analyze Delay Routes', 'Develop Route Options', 'Analyze Routes', and finally 'Uplink'.

Airport Closure

NASA04
Airport: KCOS
Route Score: 0.83
Executing new route soon: KCOS

Checklist - NASA04

Task/Subplay	LOA
Find Delayed Aircraft	Auto
Develop Delay Options	Auto
Analyze Delay Options BRANCH	Auto
Develop Route Options	Auto
Analyze Routes	Auto
Uplink	Auto

ROUTE RECOMMENDATIONS

	KCOS	KEGE	KCYS	KCYS	KCYS
Risk	0.83 (Good)	0.6 (Fair)	0.29 (Fair)	0.21 (Poor)	0.06 (Poor)
Fuel	2532 lbs	8843 lbs	8902 lbs	9903 lbs	10969 lbs
Medical	TRAUMA 10M	CLINIC 1M	TRAUMA 1M	TRAUMA 1M	TRAUMA 1M
Dist	73 NM	120 NM	89 NM	89 NM	89 NM
ETTA	9 m	11 m	21 m	21 m	21 m
Services	NASA FACILITIES	NASA FACILITIES	NASA FACILITIES	NASA FACILITIES	NASA FACILITIES

Risk Assessment

The risk assessment shows that the route is 'Good' (0.83) for KCOS, but the risk increases significantly for other destinations, reaching 'Poor' (0.06) for KCYS.

Play Manager

- See all active plays
- View actions requiring operator input
- View actions that have been performed
- Invoke Play Selector to configure and launch new play

Play Node Graph

- Visual representation of a play's structure
- Modify ALTA and override LOAs
- Displays progress of play

Recommendation Panel

- Lists ac involved in play and status
- Provides recommendation table with transparency information
- Shows selected ac's working agreement with dynamic checklist
- Used to execute recommendations
- Can be used to constrain LOA determinations

Working Agreements: Automation Level-Based Task Allocation (ALTA)

- A model to achieve contextually aware dynamic LOA determinations
- After a problem has been detected or handed to the agent, the agent will conduct an Evaluation Phase
 - Agent requests potential solutions from automated recommender
 - Evaluates on multiple dimensions (e.g., risk, flight delay, fuel)
 - Takes into account user-defined thresholds for each dimension's LOA
 - Sorts solutions by highest LOA first, then user-identified primary criterion

ALTA Action Phase

Working agreements specify, based on predetermined factors, which of the following the automation will do:

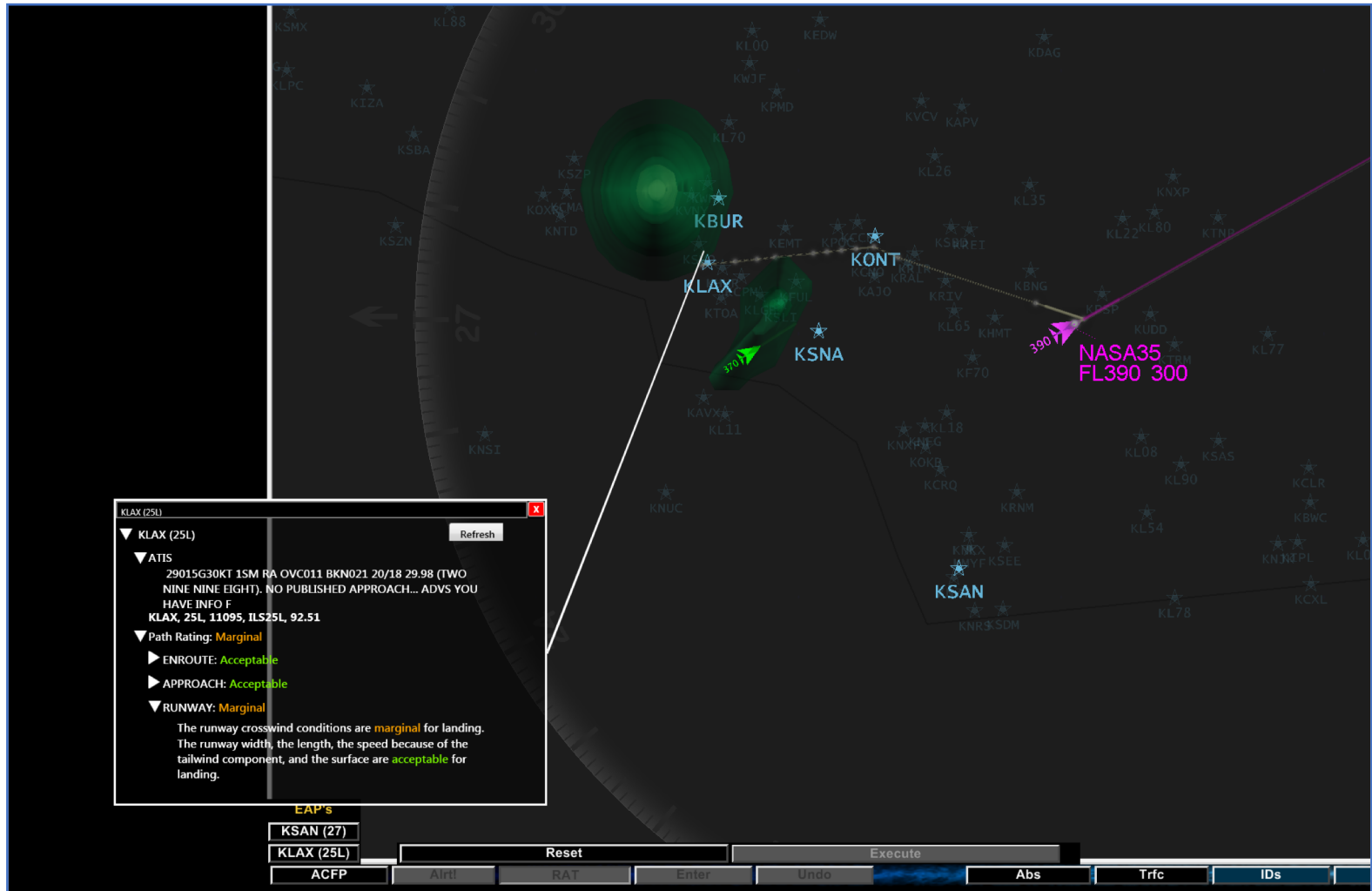
- Auto: autonomously executes and informs operator
- Veto: presents solutions one of which will be autonomously executed unless the operator intervenes
- Select: presents multiple options for operator selection
- Manual: task to be performed by operator

Aircraft List		Callsign	
✓	NASA114	New route executed	Route rating : Excellent
⌚	NASA147	Executing new route in 1m 58s	Route rating : Good
⚠	NASA166	Route waiting approval	Route rating : Acceptable
⚠	NASA167	Manual route entry required	Route rating : Unacceptable
	NASA170	-----	Calculating recommendations

Route Recommendations

	Recommended						
	KRNO(16R)	KSJC(12R)	KSMF(16L)	KSMF(16R)	KLAS(25L)	KONT(08L)	KLAS(25R)
 Risk  0.950 +	0.990 (Acceptable)	0.990 (Acceptable)	0.990 (Acceptable)	0.990 (Acceptable)	0.990 (Acceptable)	0.980 (Acceptable)	0.990 (Acceptable)
 Fuel  12000 lbs+	<u>7944 lbs</u>	7526 lbs	 6675 lbs	6660 lbs	5005 lbs	4637 lbs	4492 lbs
 Medical  Inactive	Trauma 3 M	Trauma 6 M	Trauma 10 M	Trauma 10 M	Trauma 3 M	Hospital 1 M	Trauma 3 M
 Dist AC-APT  ≤ 300 NM	51 NM	233 NM	163 NM	163 NM	321 NM	397 NM	321 NM
 ETTA P  ≤ 1h 30m	26m	1h 10m	48m	49m	1h 10m	1h 14m	1h 21m
 Path Stretch  ≤ 400 NM	-809 NM	-633 NM	-665 NM	-664 NM	-550 NM	-523 NM	-505 NM
 Facilities  Nasa Hub	Nasa Facilities	Nasa Facilities	Nasa Facilities	Nasa Facilities	Nasa Hub	Nasa Facilities	Nasa Hub

Graphical Display of Recommended Route



Concepts for other applications

- Status display for situation awareness
- Flexible, pre-scripted Plays
- Working Agreements
- Emphasis on Teaming
- Transparency to increase both situation awareness and trust and reliance on the system
- Contextually-aware levels of automation to reduce workload in safe and efficient manner
- Bi-directional communication