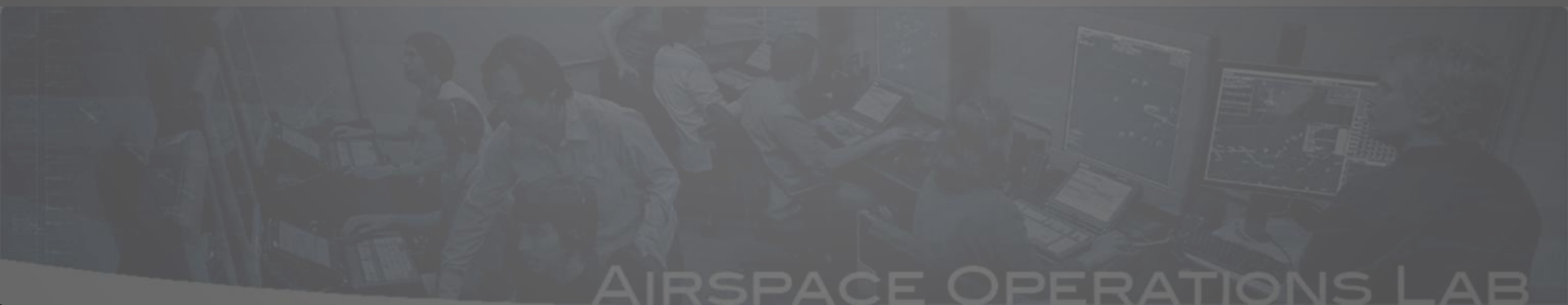# MACS Data Collection and Data Analysis

Joey Mercer & James Wong

Outline

- Data Collection Setup panel
- Types of Logs
- Location of MACS Data
- Other Influencing Factors
- Real-Time Analysis Tools
- Post-Processing Analysis Tools

Outline

- Data Collection Setup panel
- Types of Logs
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Data Collection Setup Panel

Location: Windows -> Setup Panels -> Data Collection

Data Collection Setup Panel

- Data collection "modes"
  - Start/stop data collection when MACS simulation start/stop
  - Keep data collection running

Data Collection Main Mode

◉ Start/Stop Data Collection when MACS Simulation start/stops   ○ Keep Data Collection Running   ☑ SISO Logging to new files   Controller Name DEFAULT

Outline

- Data Collection Setup panel

- **Types of Logs**

- Location of MACS Data

- Other Influencing Factors

- Real-Time Analysis

- Post-Processing Analysis Tools

Types of Logs

- What can MACS collect?
  - System-wide "general use" data
  - Flight Deck data
  - ATC data
  - Special Use ATC Automation data
  - Real-time Sim Manager changes to aircraft
  - DSR Mouse/Trackball data

Types of Logs

- What can MACS collect?
  - System-wide, "general use" data:
    - Flight State log (…Macs_FlightState…)
      - Logs the state information of every aircraft every X seconds
    - Custom log (…Macs_Custom…)
      - User-customizable log to record only the EVENTS you're interested in
        » Can include any events available in the pilot event log, controller event log, and ATC state log

General Use Data Collection Items

☑ Flight State (periodic)   ☑ include nominal data ☑ include flight plan   FlightState log rate (seconds): 1   Max Limit of Aircraft: 100

☑ Customized Events

Types of Logs

- Splitting of logs

General Use Data Collection Items

☑ Flight State (periodic)   ☑ include nominal data   ☑ include flight plan   FlightState log rate (seconds): `1`   Max Limit of Aircraft: `100`

☑ Customized Events

atcmp11_Macs_Custom_view__2011-10-04_10-35-05.log	Oct 14, 2011 7:44 PM	3.9 MB	Log File
atcmp11_Macs_FlightState_view_1_2011-10-04_10-35-05.log	Oct 14, 2011 7:43 PM	40.8 MB	Log File
atcmp11_Macs_FlightState_view_2_2011-10-04_10-35-05.log	Oct 14, 2011 7:42 PM	53.5 MB	Log File
atcmp11_Macs_FlightState_view_3_2011-10-04_10-35-05.log	Oct 14, 2011 7:44 PM	36.3 MB	Log File
atcmp11_Macs_FlightState_view_4_2011-10-04_10-35-05.log	Oct 14, 2011 7:43 PM	15.7 MB	Log File
atcmp11_Macs_FlightState_view_5_2011-10-04_10-35-05.log	Oct 14, 2011 7:41 PM	143 KB	Log File
atcmp11_Macs_SectorCrossing_view__2011-10-04_10-35-05.log	Oct 14, 2011 7:44 PM	463 KB	Log File

Types of Logs

- What can MACS collect?
  - Flight Deck data:
    - Pilot event log (...Macs_Pilot...)
      - Logs the state information of an aircraft at the time of a pilot input or flight deck event
    - FMS Trajectories log (...Macs_Traj...)
      - Logs the trajectories computed by the FMS

Flight Deck Data Collection Items

☑ Pilot Inputs and Flight Deck Events

☑ FMS Trajectories

Types of Logs

- What can MACS collect?
  - ATC data:
    - Controller event log (…Macs_Atc…)
      - Logs the state information of an aircraft at the time of a controller input or ATC event
    - ATC State log
      - Logs system-wide ATC data
        » Sector counts, conflicts and separation violations, fix crossings, etc.

Air Traffic Control Data Collection Items

☑ Controller Inputs and ATC events

☑ ATC State items (sector counts,etc.)

☑ ATC trajectory predictions (periodic)   Trajectory log rate (seconds): 60

☑ ATC Trajectory Modifications (trial plans)

☑ ATC TimeLine events

☑ ATC Traffic Load events

☑ ATC TSafe events

☑ Sector Crossing Events

Types of Logs

- ## What can MACS collect?
  - ### ATC data (continued):
    - #### ATC Trajectory log (...Macs_AtcTraj...)
      - Logs the trajectories computed by the ATC ground system for every aircraft every X seconds
    - #### ATC Trajectory Modifications log (...MACS_TrajMod...)
      - Logs trajectories associated with trial plans created by controllers and the automation

Types of Logs

- What can MACS collect?
  - ATC data (continued):
    - ATC Timeline/Meterlist log (…Macs_TimelineMeterList…)
      - Logs the ETAs and STAS of all aircraft scheduled on any available timeline
    - ATC Traffic Load log (…MACS_TrafficLoad…)
      - Logs all data displayed in the load tables and load graphs
      - Logs operator interactions with load tables and load graphs

Air Traffic Control Data Collection Items

☑ Controller Inputs and ATC events

☑ ATC State items (sector counts,etc.)

☑ ATC trajectory predictions (periodic)   Trajectory log rate (seconds): 60

☑ ATC Trajectory Modifications (trial plans)

☑ ATC TimeLine events

☑ ATC Traffic Load events

☑ ATC TSafe events

☑ Sector Crossing Events

Types of Logs

- What can MACS collect?
  - ATC data (continued):
    - ATC TSAFE log (...Macs_TSafe...)
      - Logs the resolution advisory and the uplinked resolution for all TSAFE events
      - Logs 5 minutes of aircraft flight state information for all aircraft receiving a TSAFE resolution
    - ATC Sector Crossing log (...MACS_Sector_Crossing...)
      - Logs all sector crossing events for all aircraft
      - Forces a new FMS and ATC trajectory to be computed at the time of each sector crossing
      - Computes and logs time/distance flown in sector summary data

Types of Logs

- ## What can MACS collect?
  - ### Special Use ATC Automation data:
    - #### Complexity Metrics log (…Macs_CompMet…)
      - Logs the sector characteristics for each sector owned by the local workstation
      - Logs the summary data of the ATC situation every minute
      - Logs the flight state data for all aircraft included in the ATC situation every minute
      - Logs the workload data pressed by the controller
      - Logs a forced computation of the sector characteristics and the summary data of the ATC situation at the time of any boundary change
      - Logs the traffic load's complexity values every minute across 5-minute intervals for all owned sectors
    - #### AAC Conflict Resolution SQL data logs (*.csv, *.prop)
      - Logs all information necessary to use a web-based SQL analysis
      - http://airtrafficconflictresolutions.arc.nasa.gov/

Special Use Ground Side Automation Data Collection Items
☑ Complexity Metrics
☑ Conflict Resolution Website SQL (AAC)
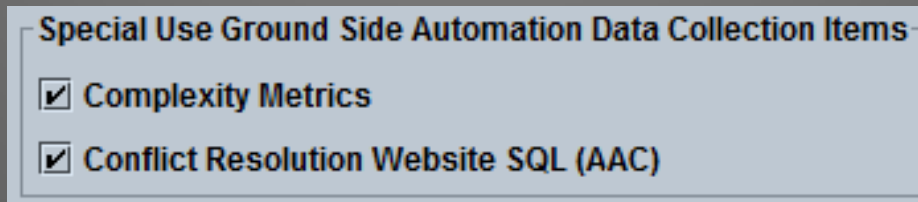
Types of Logs

- ## What can MACS collect?
  - ### Real-time Sim Manager changes to aircraft:
    - #### Sim Time AC Changes log (…SimChanges…)
      - Logs changes made in real-time to any aircraft by the sim manager
        - » Duplicate any aircraft, to be inserted in the simulation 5 minutes from now
        - » Modify an inactive aircraft
        - » Delete any aircraft
  - ### DSR Mouse/Trackball data:
    - #### DSR Mouse Events log (…MACS_MouseEvent…)
      - Logs all mouse/trackball button press and button release events
      - Only applies to operator actions made in the DSR

> Simulation Time Ac Changes by SimManager
> ☑ Save sim time ac changes
>
> DSR Mouse Events
> ☑ DSR Mouse Events

Types of Logs

- ## Wait! There's one more…
  - ### Workload Assessment Keypad data
    - #### Workload log (…Wkload…)
      - Logs the real-time workload ratings of participants
      - On a 1-6 scale, every X interval
      - NOT controlled by the Data Collection Setup panel, but by the MACS Windows Setup panel (Windows -> Setup Panels -> MACS Windows Setup)

Types of Logs

- How many was that?
  - 17

  - Event-driven (15):
    - Custom log
    - Pilot Event log
    - FMS Trajectory log
    - Controller Event log
    - ATC State log*
    - ATC Trajectory Modifications log
    - Timeline/Meterlist log
    - Traffic Load log*
    - TSAFE log
    - Sector Crossing log
    - Complexity log*
    - AAC log
    - Sim Changes log
    - Mouse Events log
    - Workload log

  - Periodic/Interval-driven (5):
    - Flight State log
    - ATC State log*
    - ATC Trajectory log
    - Traffic Load log*
    - Complexity log*

Outline

- Data Collection Setup panel

- Types of Logs

- **Location of MACS Data**

- Other Influencing Factors

- Real-Time Analysis

- Post-Processing Analysis Tools

Location of MACS Data

- Where will my data be written?
  - Typically controlled by the Scenario Control panel
    - Location: Windows -> External Admin Tools -> Scenario Control
    - Allows the researcher to specify where the data should be written
    - If specified directory is invalid, you will not get any data!
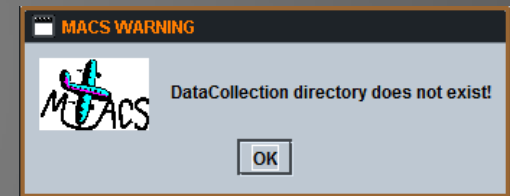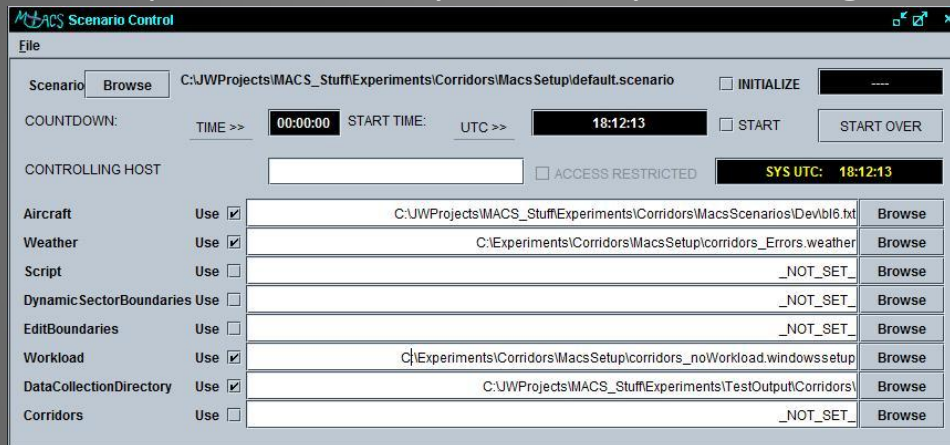
  - Can also be controlled by the Properties file:

    ```
    ####################################################
    ## directory for Macs data collection (DataCollectionDirectory)
    DataCollectionDirectory = Z:/DATA/Example_ZKC_ZID/
    ```

Outline

- Data Collection Setup panel

- Types of Logs

- Location of MACS Data

- Other Influencing Factors

- Real-Time Analysis

- Post-Processing Analysis Tools

Other Influencing Factors

- Output rate parameter from Flight Deck Setup panel does NOT affect your data
  - Designed to impacts ADRS message communication
- State source selection will indirectly affect your data
  - Surveillance data of differing quality

Outline

- Data Collection Setup panel

- Types of Logs

- Location of MACS Data

- Other Influencing Factors

- Real-Time Analysis Tools

- Post-Processing Analysis Tools

Real-Time Analysis Tools

- ## XY Trajectory Panel
  - Location: Windows -> Analysis Views -> XY Trajectory Panel

Real-Time Analysis Tools

- ## Aircraft Flight State History Panel
  - Location: Windows -> Analysis Views -> Aircraft XY Trajectory Panel
    - Real-time monitoring of aircraft flight state:
      - Altitude   - Altitude Target
      - Ground speed   - Indicated Air Speed Target
      - Heading   - Vertical Error
      - Indicated airspeed   - Thrust*
      - Target speed
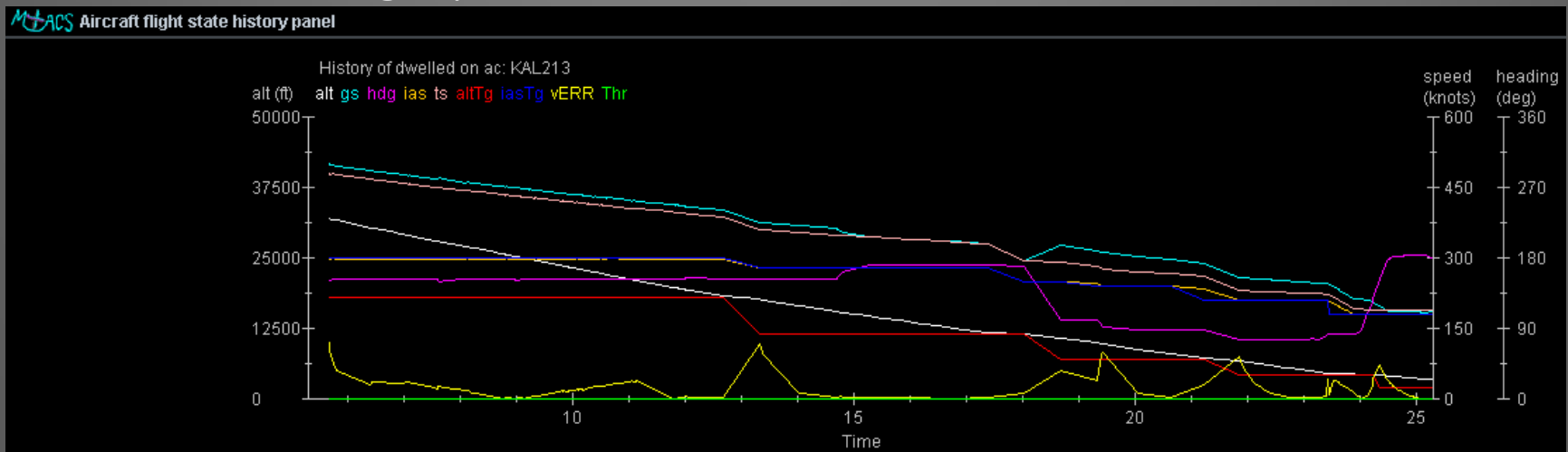
Outline

- Data Collection Setup panel

- Types of Logs

- Location of MACS Data

- Other Influencing Factors

- Real-Time Analysis

- Post-Processing Analysis Tools

Post-Processing Data Analysis Tools

- Location: Windows -> Analysis Views -> Output Log Files Analysis

- Operating Modes:
  – Observer
  – Analyst
  – Developer
  – Developer-Lite

- Tools:
  – Area Analysis
  – Filter Data
  – Conflict Analysis
  – Custom Log Analysis
  – Route Analysis
  – CMS Analysis
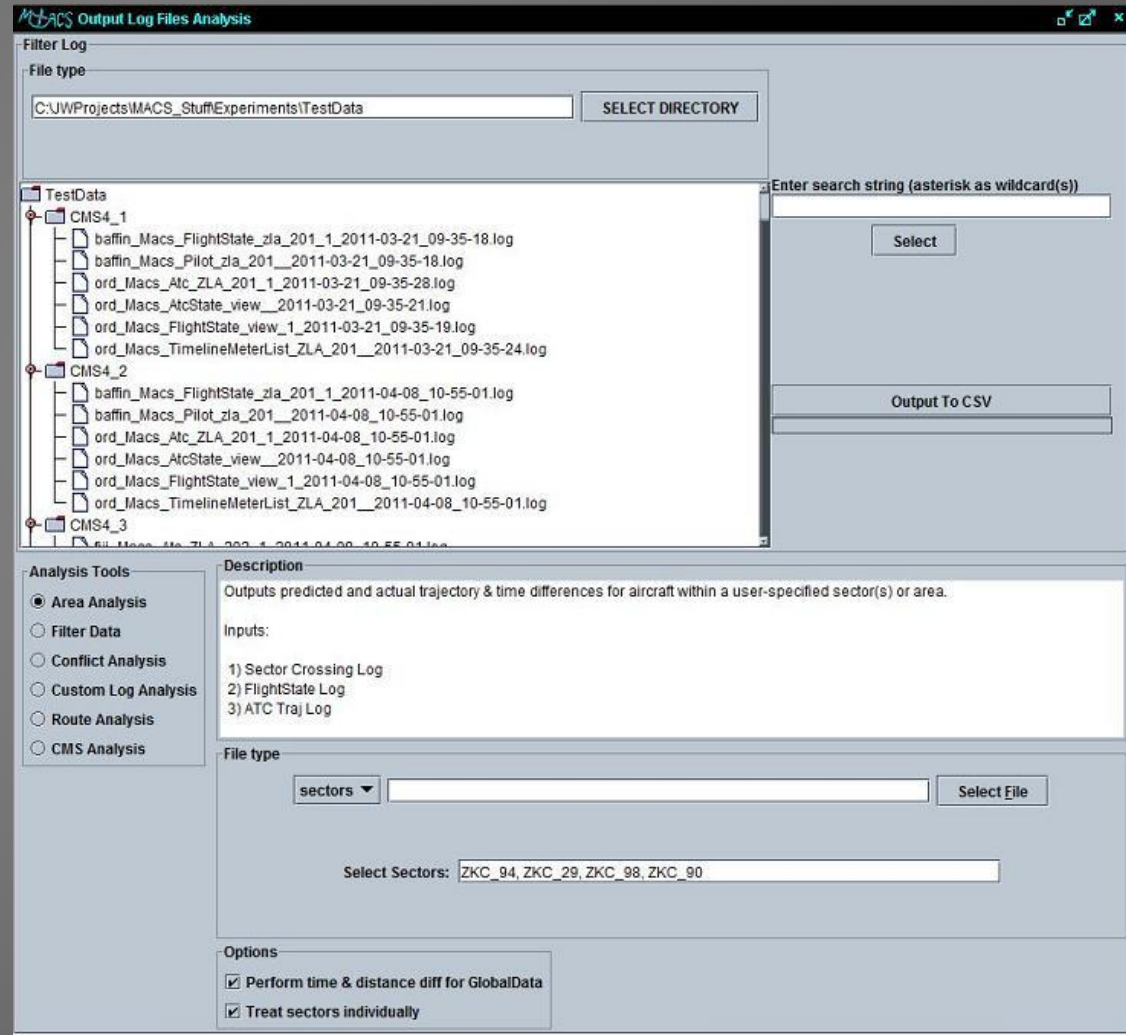
Area Analysis Tool

- Outputs predicted and actual trajectory & time differences for aircraft within a user-specified sector(s) or area

- Input:
  - Sector Crossing Log File
  - FlightState Log File
  - ATC Trajectory Log File
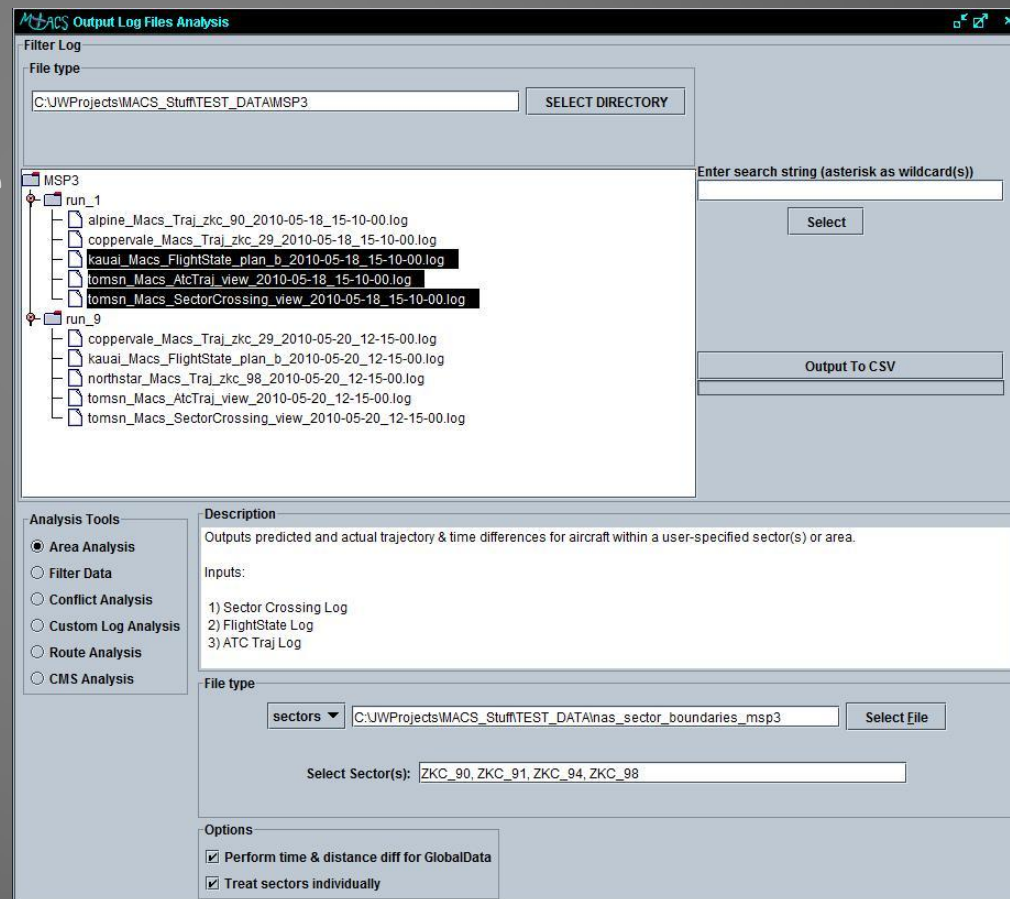
Area Analysis Tool

Sector Analysis
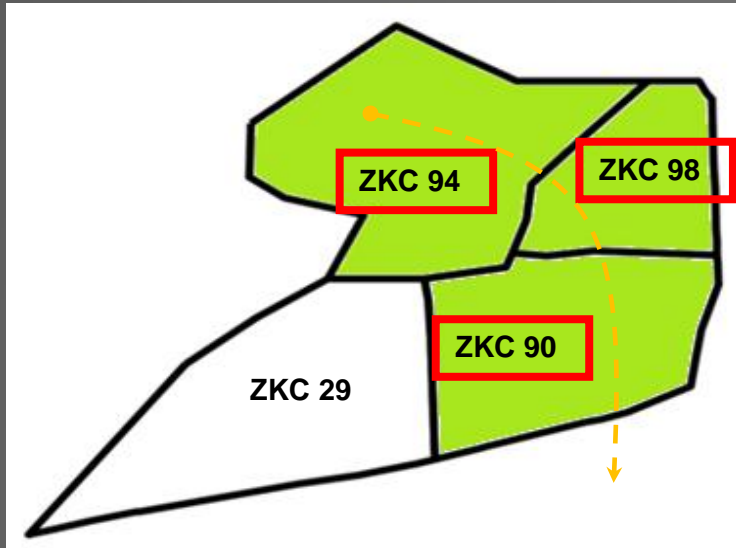
Box Analysis
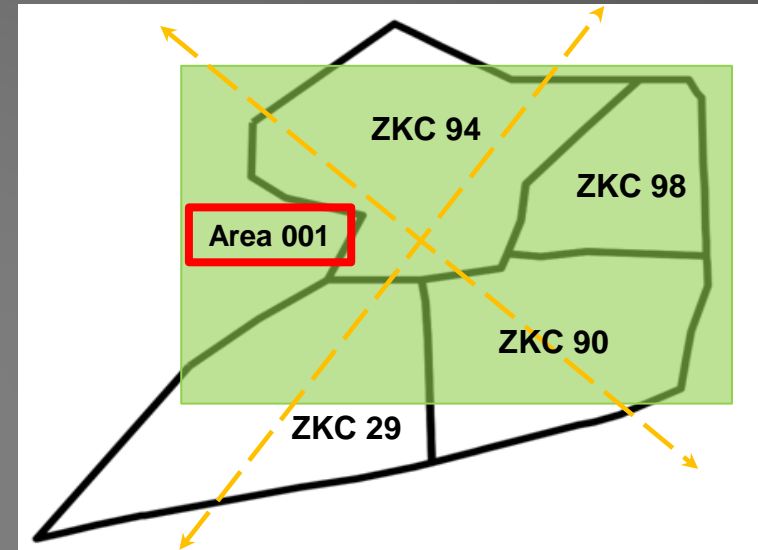
- Output:
  - Aircraft timeline through sector or area
  - Path and time differences through sector or area

location	ATC_TRAJ	Sector	callsign	time	GLOBAL_MAP Path Difference	EVENT_TYPE Time Difference	UTC_TIME	REL_TIME
IN	fiji_Macs_	ZKC_94	UAL576	19:05:21	GLOBAL_DATA	PredictedAtcTraje	19:05:21	20
EXIT	fiji_Macs_	ZKC_94	UAL576	19:09:23	GLOBAL_DATA	PredictedAtcTraje	19:09:23	262
ENTER	fiji_Macs_	ZKC_98	UAL576	19:09:23	GLOBAL_DATA	PredictedAtcTraje	19:09:23	262
EXIT	fiji_Macs_	ZKC_98	UAL576	19:14:26	GLOBAL_DATA	PredictedAtcTraje	19:14:26	565
ENTER	fiji_Macs_	ZKC_90	UAL576	19:14:26	GLOBAL_DATA	PredictedAtcTraje	19:14:26	565
EXIT	fiji_Macs_	ZKC_90	UAL576	19:16:27	GLOBAL_DATA	PredictedAtcTraje	19:16:27	687
ENTER	fiji_Macs_	ZKC_31	UAL576	19:16:27	GLOBAL_DATA	PredictedAtcTraje	19:16:27	687
DIFF	fiji_Macs_	enter_ZKC_98_exit_ZKC_98	UAL576		0.6559601	-18		
DIFF	fiji_Macs_	enter_ZKC_90_exit_ZKC_90	UAL576		-7.935211	-10		

Filter Data Tool

- Filter text from multiple files into one file
  - Filter options:
    1. Contains
    2. And contains
    3. Or contains
    4. And does not contain
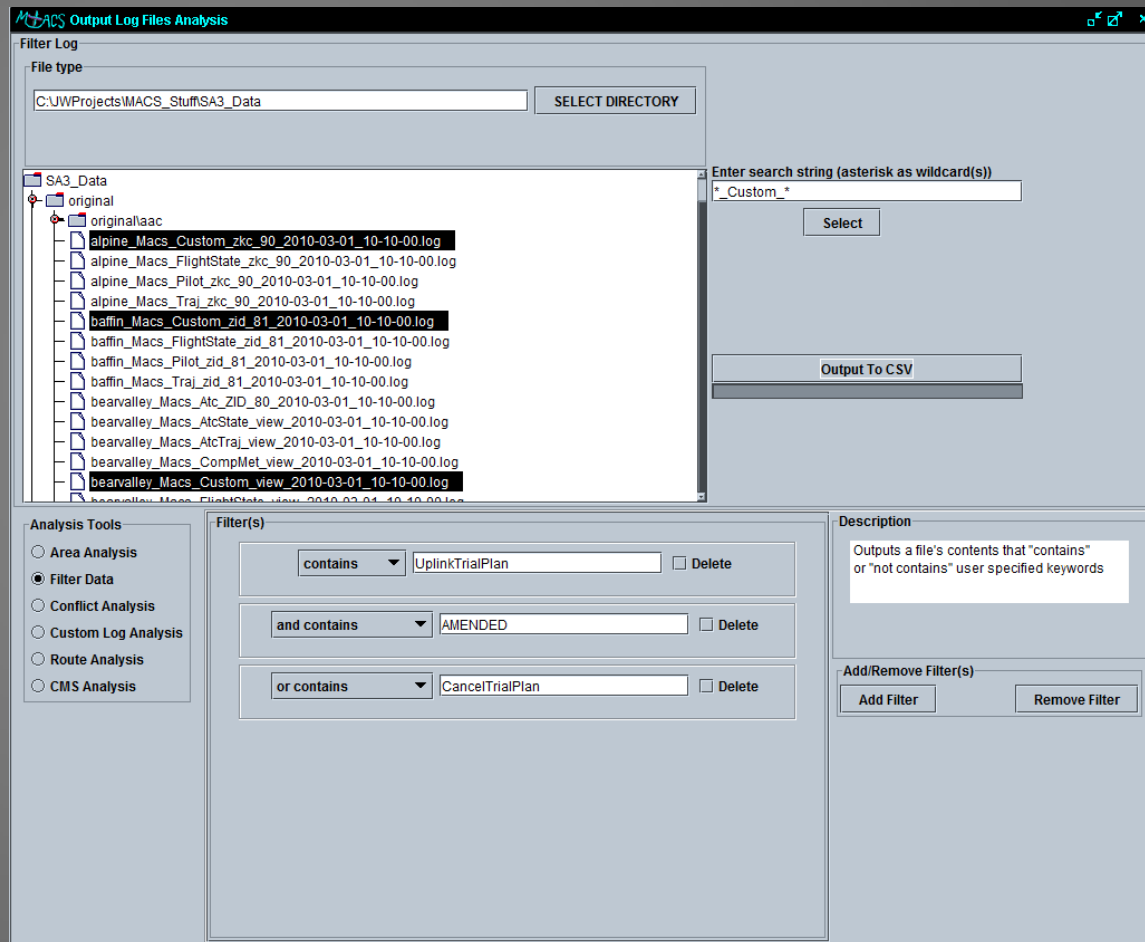
Filter Data Tool

- Input:
  - any text based files (i.e.. Log files, ASCII files)

- Sample Output:

File Source	Data													
bearvalley_Macs_	CancelTrialPlan_a	cancel trial planning		74	18:11:14	11:14.5	SAY210	B777	ZAU_44	ZAU_44	OVRFL		1	TFR
bearvalley_Macs_	CancelTrialPlan_a	cancel trial planning		90	18:11:30	11:30.1	SWA112	B75C	ZID_80	ZID_80	OVRFL		1	TFR
bearvalley_Macs_	CancelTrialPlan_a	cancel trial planning		104	18:11:44	11:44.9	NWA761	B75C	ZID_80	ZID_80	OVRFL		1	TFR
bearvalley_Macs_	UplinkTrialPlan_a	UPLINK CLEARANCE ; ;NWA761ROUTE AMENDED ; EWR./.39424		104	18:11:44	11:44.9	NWA761	B75C	ZID_80	ZID_80	OVRFL		1	TFR
bearvalley_Macs_	CancelTrialPlan_a	cancel trial planning		172	18:12:52	12:52.5	JGO885	G4	ZID_89	ZID_89	OVRFL		1	TFR
bearvalley_Macs_	UplinkTrialPlan_a	UPLINK CLEARANCE ; ;JGO885ROUTE AMENDED ; CYYZ./.394121		172	18:12:52	12:52.5	JGO885	G4	ZID_89	ZID_89	OVRFL		1	TFR
bruner_Macs_Cus	CancelTrialPlan_a	cancel trial planning		239	18:13:59	13:59.8	CTN497	B777	ZKC_98	ZKC_98	OVRFL		1	TFR
bruner_Macs_Cus	UplinkTrialPlan_a	UPLINK CLEARANCE ; ;CTN497ROUTE AMENDED ; IAH./.384957		239	18:13:59	13:59.8	CTN497	B777	ZKC_98	ZKC_98	OVRFL		1	TFR
bruner_Macs_Cus	CancelTrialPlan_a	cancel trial planning		478	18:17:58	17:58.7	BAG363	B75C	ZID_80	ZID_89	OVRFL		1	TFR
bruner_Macs_Cus	CancelTrialPlan_a	cancel trial planning		488	18:18:08	18:08.6	LDA886	B75C	ZID_80	ZID_89	OVRFL		1	TFR
bruner_Macs_Cus	CancelTrialPlan_a	cancel trial planning		696	18:21:36	21:36.3	MSR310	B75C	ZID_82	ZID_89	ARR		1	TFR
conny_Macs_Cust	UplinkTrialPlan_a	UPLINK CLEARANCE ; ;MSR310ROUTE AMENDED ; CLT./.390611		696	18:21:36	21:36.3	MSR310	B75C	ZID_82	ZID_89	ARR		1	TFR
conny_Macs_Cust	CancelTrialPlan_a	cancel trial planning		228	18:13:49	13:49.2	FCA134	B73C	ZKC_14	ZID_82	ARR		1	TFR

Conflict Analysis Tool

- Outputs sequence of DataLink/Conflict/TSAFE events associated with each aircraft within the simulation by Time
- Input:
  - ATC State Events Log File
  - ATC Events Log File
  - TSAFE Events Log File
  - Pilot Events Log File
- Sample Output:

*********** Conflict Metrics **************

**** Conflict between AC1: AAL152 <-> AC2: AAL631

**** event	rel time	elapsed time	to aircraft	ac1Owner	ac1GeoSector	ac2Owner	ac2GeoSector	timeToConflict or Initial Loss (secs)	vertical Sep (FT)	lateral Sep (NM)	eventData
ConflictAlert_s	80089	556		ZKC_98	ZID_88	ZKC_98	ZID_88		0	2.009100676	
SeparationViolation_s	80089	556		ZKC_98	ZID_88	ZKC_98	ZID_88		0	1.942949507	
ConflictProbe_s	80090	557		ZKC_98	ZID_88	ZKC_98	ZID_88	9	0	0	
SeparationViolation_s	80090	557		ZKC_98	ZID_88	ZKC_98	ZID_88		0	1.917146712	
DatalinkMsgUplinked_a	80090	557	AAL152	ZKC_98	ZID_88						CLR/FNAAL152
CancelTrialPlan_a	80090	557	AAL152	ZKC_98	ZID_88						cancel trial planning
UplinkTrialPlan_a	80090	557	AAL152	ZKC_98	ZID_88						UPLINK CLEARANCE ;
DatalinkMsgUplinkRecvd_p	80090	557	AAL152		ZKC_98		ZID_88				

**** Summary Metrics	Avg_Vert	Avg_Lat(nm)	Avg_Diag_Sep(nm)	Min_Diag_Sep(nm)	LOS_Duration	Counts_Per_Sector	Counts_Per_AcOwner
SeparationViolation	0	2.9644012	2.9644012	1.5590836	123	ZID_88: 1	ZKC_98: 1
ConflictProbe	0	0.31518987	0.31518987	0		ZID_88: 1	ZKC_98: 1
ConflictAlert	0	6.00337	6.00337	1.5698445		ZID_88: 1	ZKC_98: 1

Custom Log Analysis Tool

- TrialPlan Analysis – Displays trial plan events by time
  - Input: Custom Events Log File
 - Output: Sequence of events sorted by time

filename	callsign	relTime	time	geo	diffTime	log	event data
bearvalley	MMD090	700	18:21:41	ZKC_98	0	StartTrialPlan_a	start trial plan
bearvalley	MMD090	703	18:21:44	ZKC_98	3	TrialPlanRoute_a	ACCEPT TRIAL PLAN ROUTE SDF MMD090
bearvalley	MMD090	707	18:21:48	ZKC_98	4	TrialPlanInsertPoint_a	inserting point before SDF
bearvalley	MMD090	713	18:21:54	ZKC_98	6	TrialPlanInsertPoint_a	stop dragging
bearvalley	MMD090	718	18:21:59	ZKC_98	5	DatalinkMsgUplinked_a	CLR/FNMMD090,0089/FT ** ROUTE CLEARANCE **
bearvalley	MMD090	718	18:21:59	ZKC_98	0	CancelTrialPlan_a	cancel trial planning
bearvalley	MMD090	718	18:21:59	ZKC_98	0	UplinkTrialPlan_a	UPLINK CLEARANCE ; ;MMD090ROUTE AMENDED: L
DIFF	MMD090				18	StartTrialPlan_DatalinkMsgUplinked	

- ETA/STA Analysis – Displays ETA/STA time Differences at Sector Crossing events
  - Input: Custom Events Log File, TimeLine Log File
  - Output: ETA/STA time difference

TimeLineLog	CustomLog	eventTime	timeline	sta	eta	sta - eta	sta/eta frozen	event	eventData	relEventTime	eventTime	callSign
menorca_Mac	bearvalley_Ma	18:17:58	BNA	18:53:21	18:52:18	63	TRUE	SectorBoundaryCrossed	left sector ZKC_30, crossed into ZKC_28	477	18:17:58	AUB051
menorca_Mac	bearvalley_Ma	18:19:23	BNA	18:53:21	18:52:18	63	FALSE	SectorBoundaryCrossed	left sector ZKC_28, crossed into ZKC_29	562	18:19:23	AUB051
menorca_Mac	bearvalley_Ma	18:21:32	BRDON	18:57:00	18:57:52	-52	TRUE	SectorBoundaryCrossed	left sector ZAU_44, crossed into ZKC_92	691	18:21:32	CCA727
menorca_Mac	bearvalley_Ma	18:24:32	BRDON	18:57:00	18:58:23	-83	TRUE	SectorBoundaryCrossed	left sector ZKC_92, crossed into ZKC	871	18:24:32	CCA727
menorca_Mac	bearvalley_Ma	18:24:35	BRDON	18:57:00	18:58:23	-83	TRUE	SectorBoundaryCrossed	left sector ZKC, crossed into ZAU_44	874	18:24:35	CCA727
menorca_Mac	bearvalley_Ma	18:15:08	RUGBB	19:04:00	19:04:06	-6	TRUE	SectorBoundaryCrossed	left sector ZID_80, crossed into ZKC_98	307	18:15:08	NWA761
menorca_Mac	bearvalley_Ma	18:18:50	RUGBB	19:04:00	19:04:06	-6	TRUE	SectorBoundaryCrossed	left sector ZKC_98, crossed into ZAU_44	529	18:18:50	NWA761
menorca_Mac	bearvalley_Ma	18:23:59	RUGBB	19:04:00	19:04:06	-6	TRUE	SectorBoundaryCrossed	left sector ZAU_44, crossed into ZKC_94	838	18:23:59	NWA761
menorca_Mac	bearvalley_Ma	18:12:25	TYGER	18:55:00	18:55:21	-21	TRUE	SectorBoundaryCrossed	left sector ZID_80, crossed into ZKC_98	144	18:12:25	SWA112
menorca_Mac	bearvalley_Ma	18:18:45	TYGER	18:55:00	18:55:01	-1	TRUE	SectorBoundaryCrossed	left sector ZKC_98, crossed into ZKC_94	524	18:18:45	SWA112

Route Analysis Tool – sim start

- Outputs path & time differences between predicted trajectory and actual flight path

- Background:

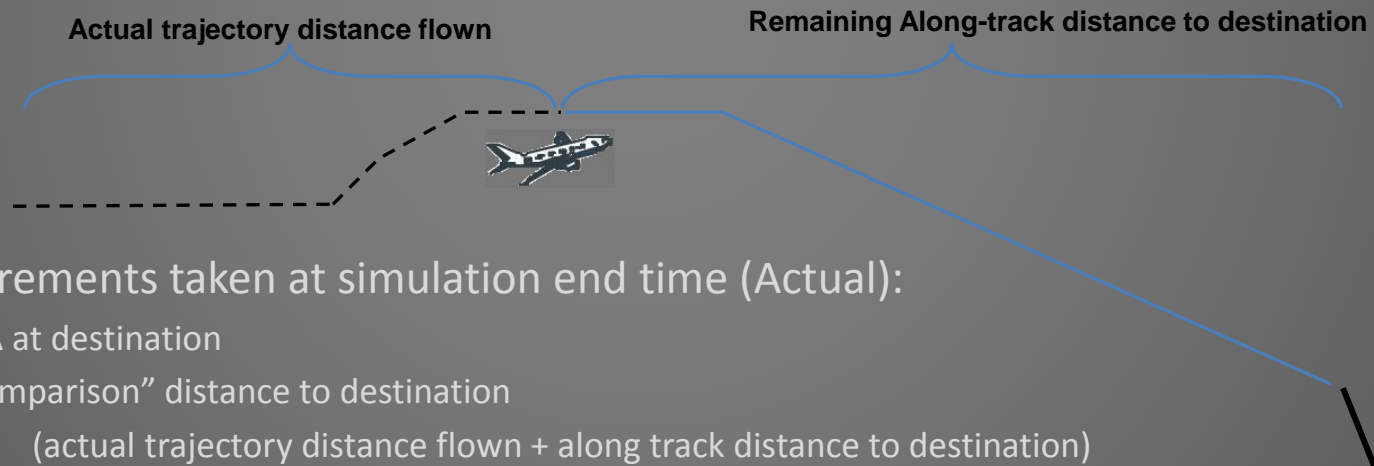**❖ flight plan trajectory**

along-track distance to destination
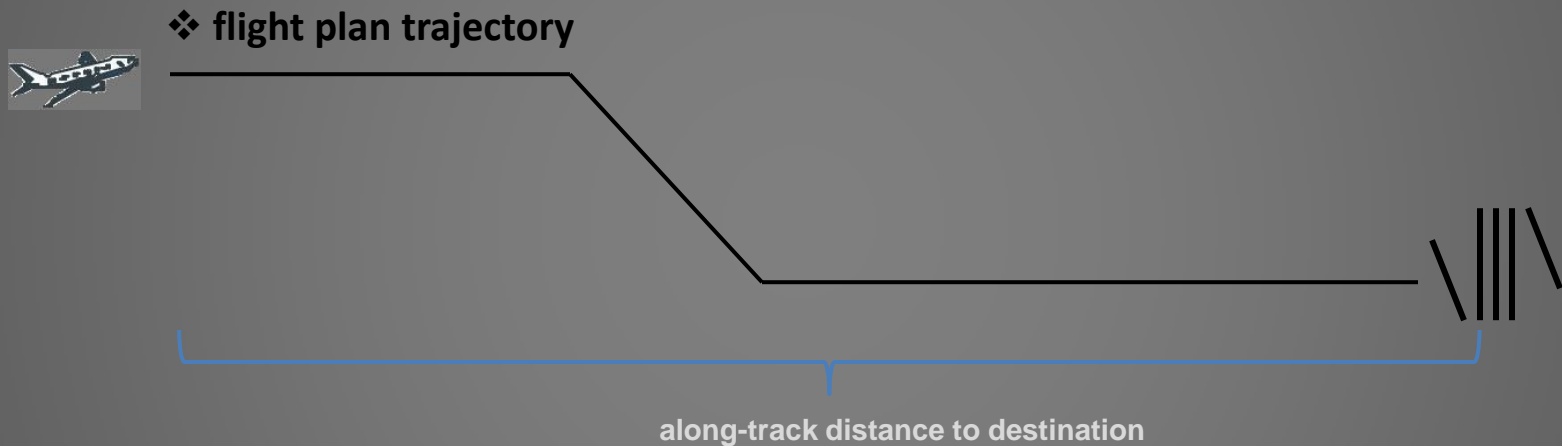
- Measurements taken at simulation start time (Planned):
  - ETA at destination
  - along-track distance to destination

# Route Analysis Tool - sim end

❖ **if no trajectory modifications occur**

Actual trajectory distance flown

Remaining Along-track distance to destination

❖ **if trajectory modifications occur**

Actual trajectory distance flown

Remaining Along-track distance to destination

- Measurements taken at simulation end time (Actual):
  - ETA at destination
  - "comparison" distance to destination
    - (actual trajectory distance flown + along track distance to destination)
- Analysis:
  - Planned ETA vs. Actual ETA
  - Planned along track distance to destination vs. Actual along track distance to destination

Route Analysis Tool

- Input:
  - FlightState Log File
  - FMS Traj Log File
- Output:
  - Path Difference
  - Time Difference
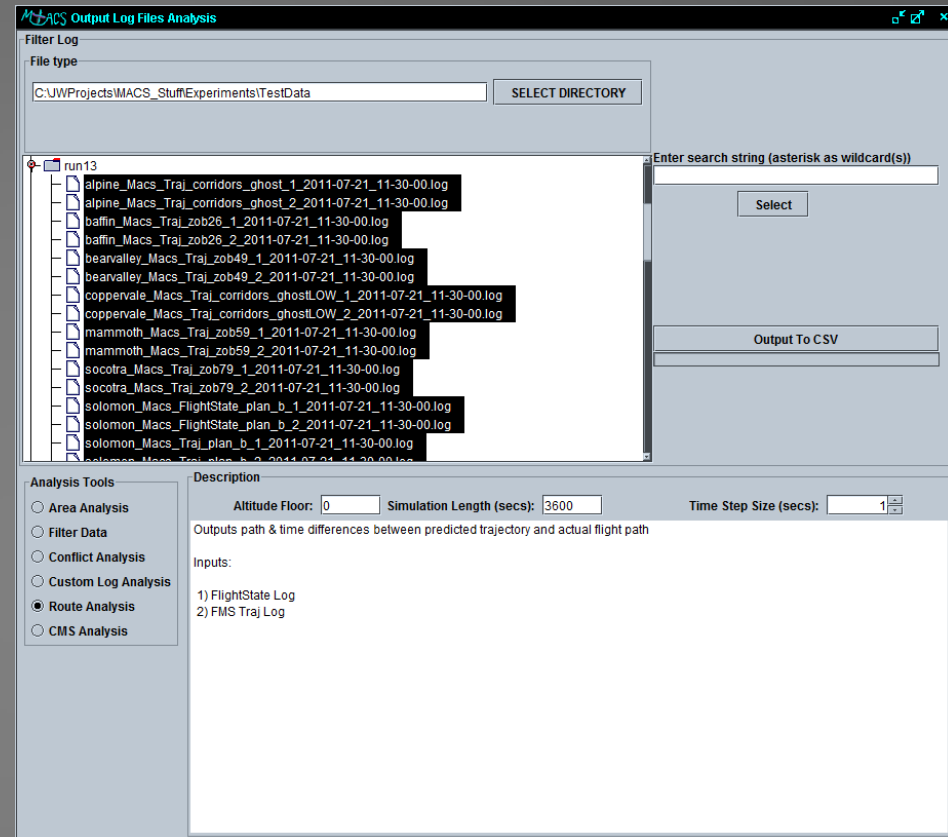
callsign	flightRules	predFmsTraj AlongTrackToDest	predFmsTraj EtaToDest	actualDistFlown	etaToDest FromTrajPt	inLnavSeconds	outLnavSeconds	pathDiff	etaDiff
SWA1450	IFR	390.2698817	21:37:50	382.3231506	21:32:19	2767	13	-7.94673	-330
AAL1063	IFR	365.1180038	21:45:09	357.2070618	21:41:36	3308	12	-7.91094	-212
ACA985	TFR	344.1252632	21:37:00	336.2247314	21:34:23	2862	12	-7.90053	-156
DAL249	TFR	367.1191754	21:41:28	359.2406921	21:37:52	3104	12	-7.87848	-215
WJA1245	TFR	429.9324036	21:45:56	422.0585022	21:43:31	3408	13	-7.8739	-144
N975RR	IFR	206.6821289	21:19:10	198.8411102	21:14:40	1702	12	-7.84102	-270
N414TR	TFR	397.6640835	21:36:07	389.8297729	21:30:22	2652	12	-7.83431	-344
FIV699	TFR	394.8401489	21:35:48	387.026062	21:30:34	2664	12	-7.81409	-313
NAC756	IFR	348.0309067	21:42:35	340.2409973	21:38:40	3134	12	-7.78991	-234
TCF7615	TFR	346.6830554	21:31:18	338.9114685	21:28:28	2519	13	-7.77159	-170

CMS Analysis Tool

- Event-based data analysis of CMS data logs
  - Schedule conformance of STA vs. ETA
  - xyAlongTrackDist vs. nominal XYAlongTrackDist
  - Speed Advisory Data

CMS Analysis Tool

- Input:
  - FlightState log File(Pilot and ATC stations)
  - ATC Log File
  - AtcState Log File
  - TimelineMeterList Log File

- Output:
  - At the time of any controller or pilot action – event based output
    - STA / ETA time difference in seconds
    - displayed speed advisory
    - alongTrackDistToDestination vs. nominal AlongTrackDistanceToDestination

callsign	eventTime	speedAdvisory	timeline	sta arrivalTime	eta arrivalTime	sta - eta	xyAlongTrackDist	nomXYAlongTrackDist	nomXYAlongTrackDist - xyAlongTrackDist	event	event data
ASA848	17:09:52	250 CULVE	CULVE	17:21:22	17:21:15	7	88.04712	89.04936	1.002243	AcHandedOff_a	hand off to sector: ZLA_201
ASA848	17:09:52	250 CULVE	CULVE	17:21:22	17:21:15	7	88.04712	89.04936	1.002243	AcceptHandoff_a	HANDOFF ACCEPTED ASA848
ASA848	17:15:17	210 CULVE	CULVE	17:21:22	17:20:44	38	51.45197	55.25799	3.8060226	SectorBoundaryCrossed_a	left sector ZLA_13, crossed into ZLA_201
ASA848	17:20:36	L 0:04	CULVE	17:20:48	17:20:52	-4	28.41309	28.21082	-0.20227051	SectorBoundaryCrossed_a	left sector ZLA_201, crossed into ZLA
ASA848	17:10:14	250 CULVE	CULVE	17:20:52	17:21:13	-21	85.21399	82.90646	-2.3075256	SelectAc_p	Aircraft Selected: selected = ASA848
ASA848	17:12:12	240 CULVE	CULVE	17:21:22	17:20:54	28	70.767975	73.16579	2.397812	McpSpeedVnavOn_p	target speed: 270
ASA848	17:13:47	210 CULVE	CULVE	17:21:22	17:20:39	43	60.160393	63.782345	3.621952	SelectAc_p	Aircraft Selected: selected = ASA848
ASA848	17:18:43	210 CULVE	CULVE	17:21:22	17:20:44	38	34.697266	37.235783	2.538517	SelectAc_p	Aircraft Selected: selected = ASA848
ASA848	17:18:47	E 0:02	CULVE	17:20:48	17:20:45	3	34.405766	35.998726	1.5929604	ShippedAc_p	122.1

Questions?

- Data Collection Setup panel

- Types of Logs

- Location of MACS Data

- Other Influencing Factors

- Real-Time Analysis Tools

- Post-Processing Analysis Tools

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