ATM Seminar USA & Europe
AIR TRAFFIC MANAGEMENT
RESEARCH AND DEVELOPMENT

Leveraging local ADS-B transmissions to assess the performance of air traffic at general aviation airports

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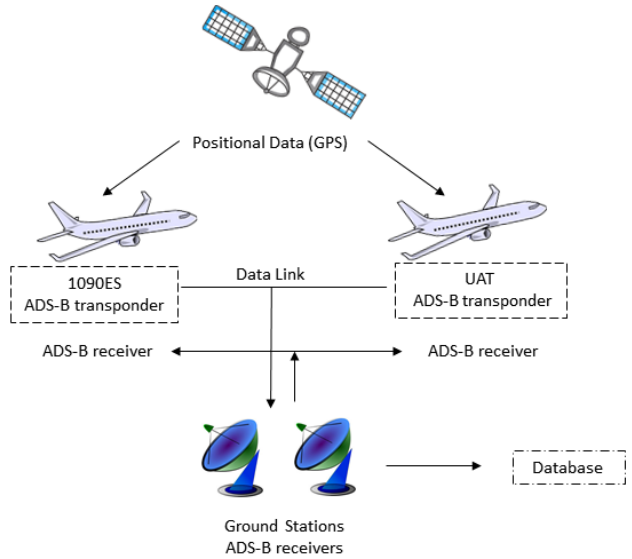
Motivation

- No ATC towers in most GA airports
- Need for flight tracking and operation counts
- Thousands of GA airports across the US
- Operation counts assist capacity estimation
  - MITRE is building a capacity estimation model for GA airports, and its inputs are expected to include the kinds of data that could be collected automatically with a system such as this.

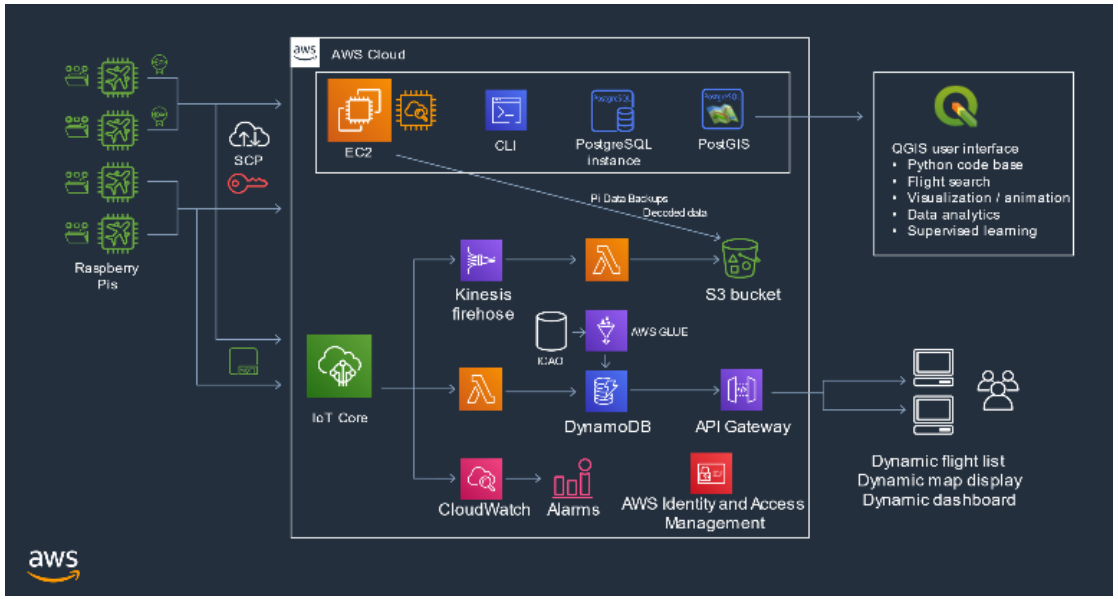
ADS-B Data

- Automatic Dependent Surveillance-Broadcast is intended to supplement ground-based radars
- Aircraft can broadcast their own position, altitude, speed etc.
- Collecting real-time data from four airports: KCGS, KOSU, KFRG, KGFK

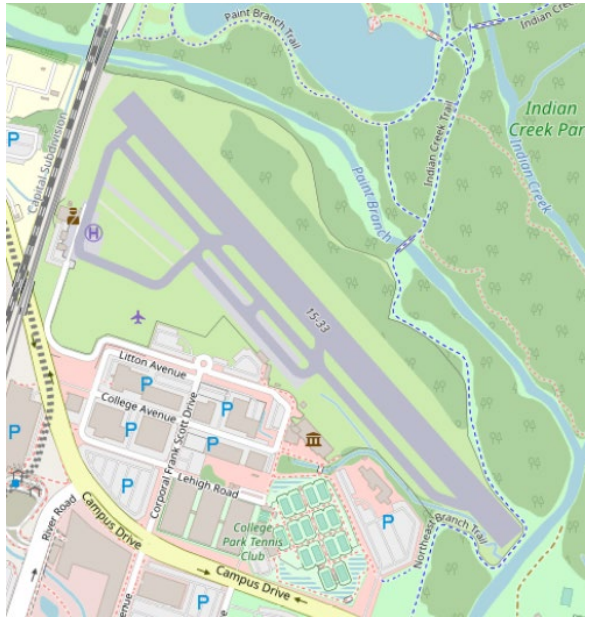


ADS-B Data Collection

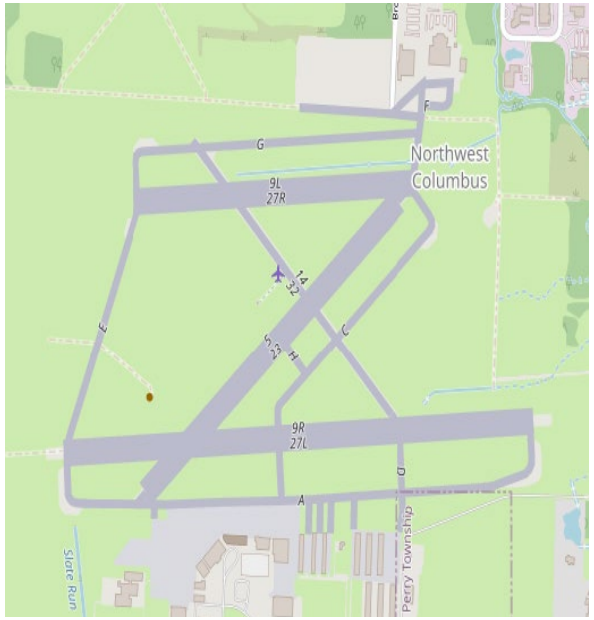
- ADS-B receivers collecting data at each airport (separate for 1090 and 978 MHz)
- Aircraft messages get decoded providing: icao address, lat, long, alt, gs, trk, roc
- All information is stored in our online PostGres SQL database



Study locations

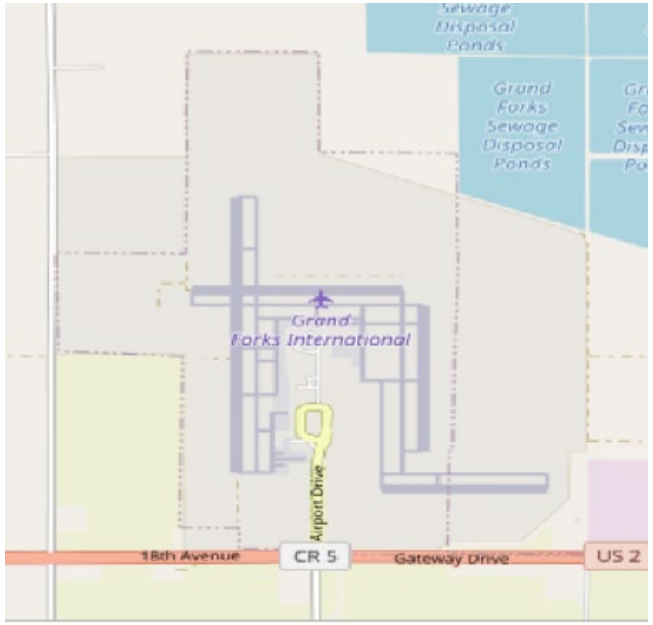


College Park Airport, College Park, MD (KCGS)



The Ohio State University Airport, Columbus, OH (KOSU)

Republic Airport, Farmingdale, NY (KFRG)



Grand Forks International Airport, Grand Forks, ND (KGFK)

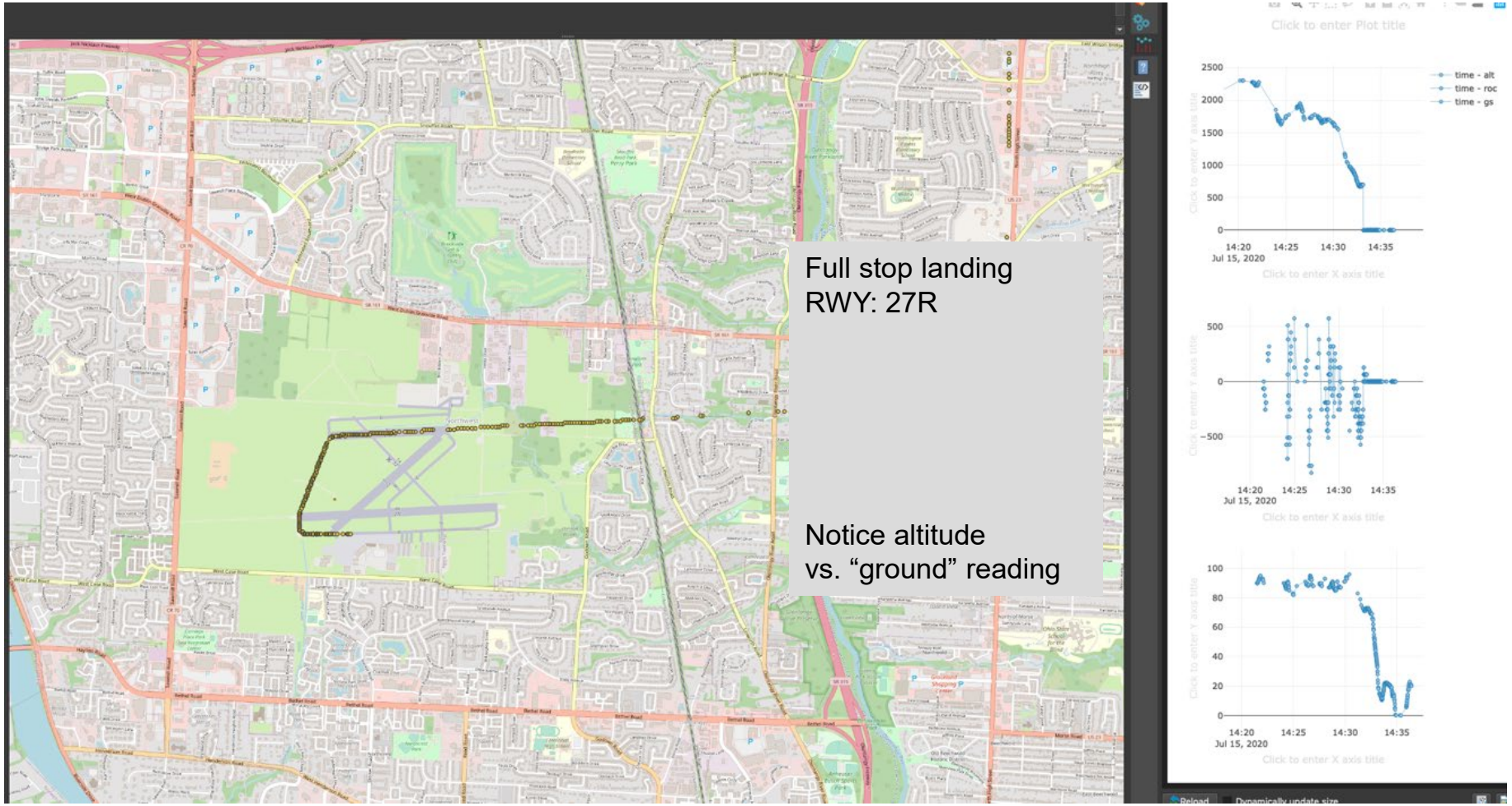
Categorizing operations using ADS-B data

- LSTM Neural Network model
- Inputs: Vectors of flight information (time, alt, gs)

  8 Labels
- Subset of flights was manually classified through tools created based on QGIS (training dataset: 7651 flights)
- Varying number of messages in each flight

Code	Operation Type
0	No Operation
1	Touch and go
2	Low approach
3	Landing and then take off
4	Take off and then landing
5	Landing
6	Take off
7	Taxiing

Using QGIS for manual classification



ADS-B Data

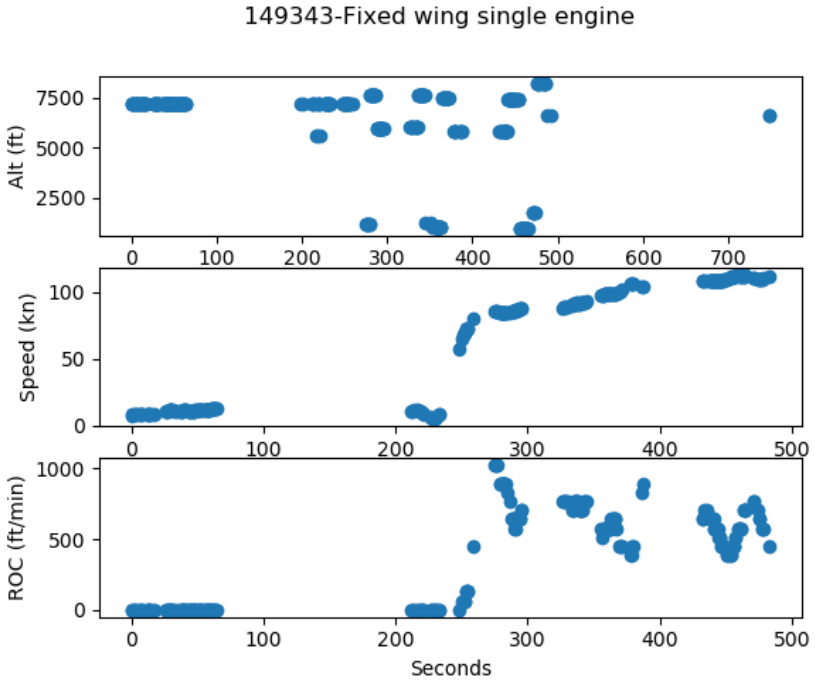
- 94% accuracy in training stage
- 92.9% accuracy in testing stage

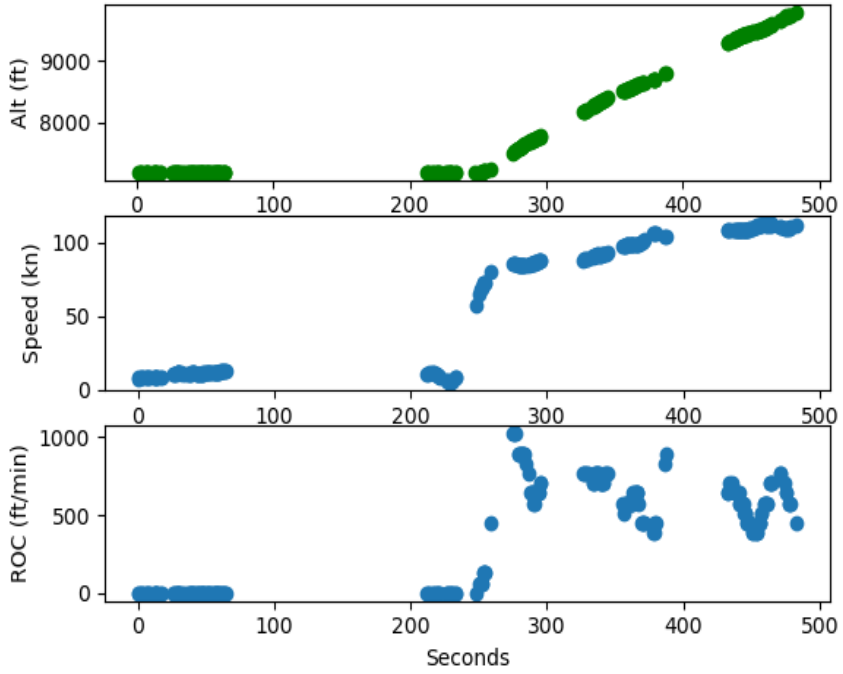
- Each flight is labeled
- Determine the number of operations per type per airport

		Predicted operation (Code)							
		0	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Actual Operation (Code)	**0**	0	0	0	0	0	0	0	3
	1	0	5	0	0	1	5	1	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	1	0	0	0	0
	4	0	0	0	0	1	0	0	0
	5	0	0	0	0	0	116	0	2
	6	0	0	0	1	0	0	117	3
	7	0	0	1	0	1	1	1	26

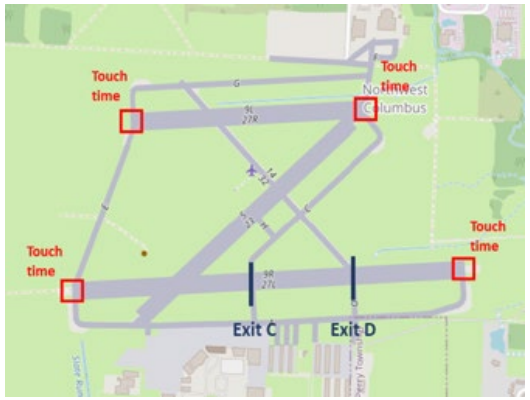
Dealing with unreliable data

- Estimate altitude from roc for faulty altitude data





Measuring Performance – Approach Speed



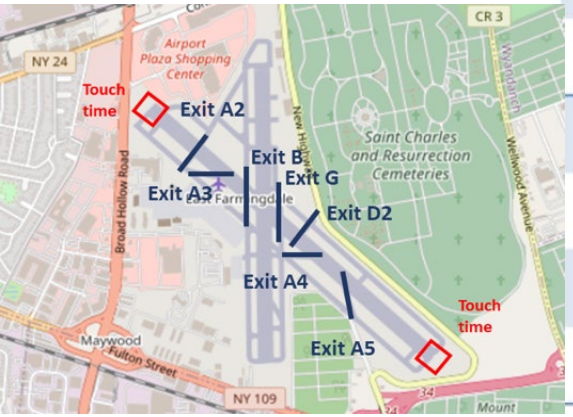
Average Approach Speed - KOSU

Average Approach Speed (knots)

Runway	AVG	Aircraft Type		Engine Type			Operation Type	
		S	M	P	T	J	TNG	FS
9L	63	63	--	63	--	--	63	--
9R	78	72	108	69.5	87	108.5	--	78
27R	61	61	--	61	--	--	61	--
27L	92	75	117	71	102	116	--	92
5		--	--	--	--	--	--	--
23	64	64	--	64	--	--	--	64

Aircraft Type: (S = Single Engine, M = Multi-Engine)
Engine Type: (P = Piston, T = Turboprop, J = Jet)
Operation Type: (TNG = Touch and Go, FS = Full Stop)

Measuring Performance – Approach Speed



Average Approach Speed - KFRG

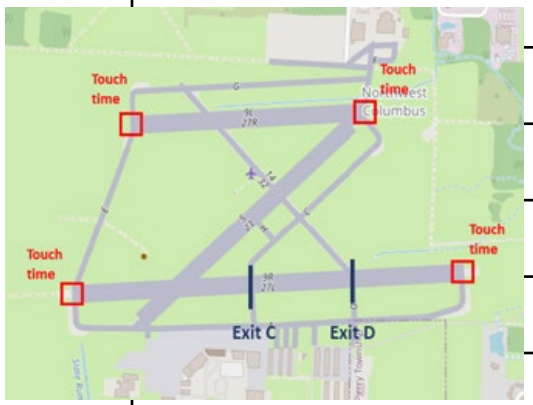
Average Approach Speed (knots)

Runway	AVG	Aircraft Type		Engine Type			Operation Type	
		S	M	P	T	J	TNG	FS
14	69	69	--	69	--	--	--	69
32	91	67	120	67	--	120	68	93
1	61	61	--	61	--	--	--	61
19	74	64	113	64	136	90	--	74

Aircraft Type: (S = Single Engine, M = Multi-Engine)
Engine Type: (P = Piston, T = Turboprop, J = Jet)
Operation Type: (TNG = Touch and Go, FS = Full Stop)

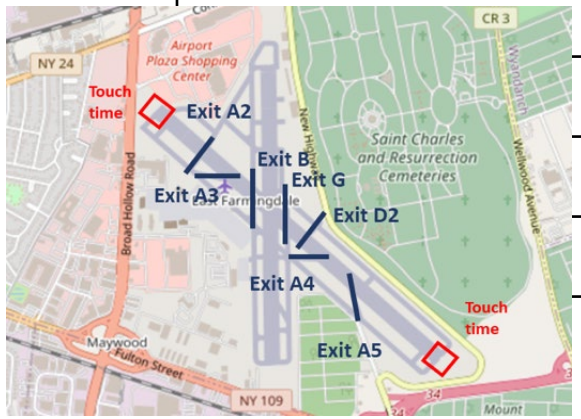
Measuring Performance – Runway Occupancy Time

Airport	Runway used for landing	Exit used for landing	AROT per aircraft type (secs)	
			Fixed wing single engine	Fixed wing multi engine
KOSU	9L	End of runway	43	--
	9R	Exit C	34	--
	9R	Exit D	48	34
	9R	End of runway	--	64
	27R	End of runway	49	67
	27L	Exit D	28	--
	27L	Exit C	45	30
	27L	End of runway	--	98
	5	End of runway	82	--
	23	End of runway	80	--



Measuring Performance – Runway Occupancy Time

Airport	Runway used for landing	Exit used for landing	AROT per aircraft type (secs)	
			Fixed wing single engine	Fixed wing multi engine
KFRG	32	Exit A5	29	--
	32	Exit A4	33	34
	32	Exit B	42	40
	14	Exit B	29	--
	14	Exit G	32	36
	14	Exit A5	--	50



Future Steps

1. Clustering flights into various phases
2. Including more airports
3. Analyzing more parameters
   - Aircraft Separation
   - Departure ROT
   - Deceleration rates

Acknowledgement

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Thank You