EMBRY-RIDDLE
Aeronautical University
Ph.D. in AVIATION

Prediction of Fume Events in 14 CFR Part 121 Airline Operations Using Machine Learning Algorithms

Mary B. O'Connor, MS

INTRODUCTION

- In most passenger jet aircraft, engine bleed air is used to provide a breathable environment for passengers and crew.

- Engine bleed air can become contaminated with pyrolyzed engine oil from leaky seals in the engine, overfilled reservoirs, or poorly placed air inlets (ASHRAE, 2007; Bae Systems, 2000; van Netten, 2000), resulting in fume events.

- During fume events, passengers and crew may experience acute or chronic exposure to a complex mixture of chemical compounds.
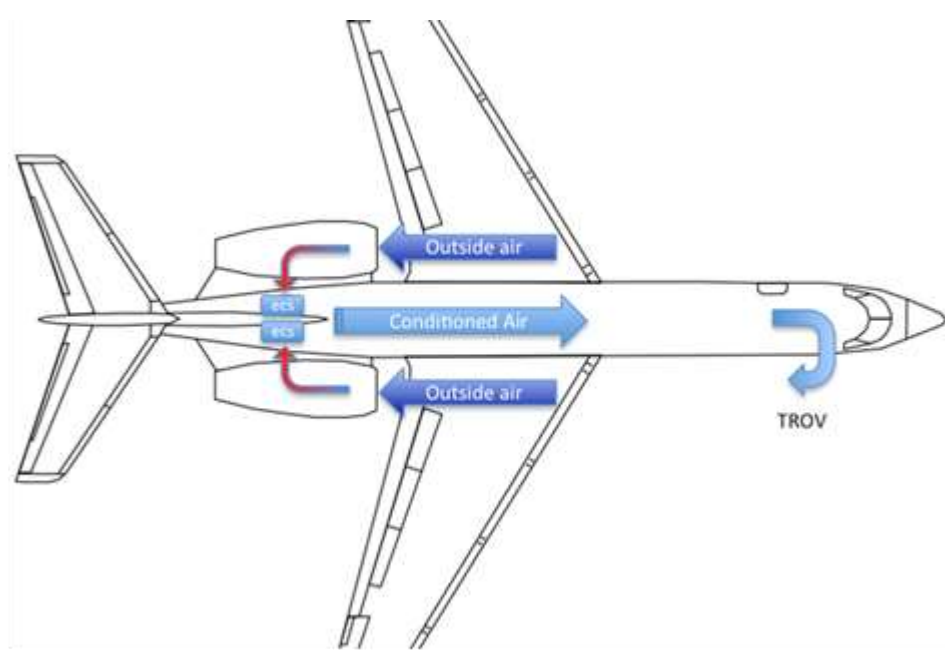

Figure 1. Simplified diagram of aircraft air conditioning and pressurization system, where ECS is the environmental control system, and TROV is the thrust recovery outflow valve. From Chattopadhyay, C. (2016) in Quora.com.

BACKGROUND

- Previous research indicates fume events are underreported by flight crews (Cox & Michaelis, 2002),

- Limited data are available on the characteristics of air quality in aircraft cabins or the potential health effects of exposure to the cabin environment (Lee, Poon, Li, & Luk, 1999).

- Fume events can result in diversions causing severe disruptions to airline schedules, passenger frustration and ill will, and considerable monetary and legal costs (Johnson, 2014; Valani et al., 2010; Holley, 2009).

- Although U.S. public law has mandated a reporting system, there is no industry-wide, systematic reporting system to track fume events (Day, 2015).

- The prediction of fume events and the resulting ability to prevent crew and passenger exposure has not been assessed.

RESEARCH QUESTIONS

- Q1: How can data mining and modeling techniques be used to predict the occurrence of a reported fume event, using variables found in voluntary reports submitted by crew?

- Q2: What are the important factors for predicting the occurrence of a fume event as identified in voluntarily reported data?

METHODS

- Aviation Safety Reporting System (ASRS) data will be used to identify smoke/fire/fumes/odor events in reports submitted by flight and cabin crew and maintenance personnel.

- Predictive models for fume events will be developed using data mining and logistic regression, decision trees, Bayesian inference, memory-based reasoning, neural networks, and random forest algorithms, based on variables found in these reports.

- A target variable representing the occurrence of a fume event will be identified. Other variables of interest are expected to be phase of flight, type of aircraft, symptoms and smells reported, and outcome of flight.

RESULTS

- Results of this study will have practical significance as can be used to increase awareness of likelihood of fume event occurrence, better prepare for mitigation of events, and highlight necessity of developing a surveillance system for tracking fume events.

- This research will have theoretical significance through the development of models using ASRS data to predict events which potentially compromise crew and passenger health and safety.

REFERENCES

References available on request.