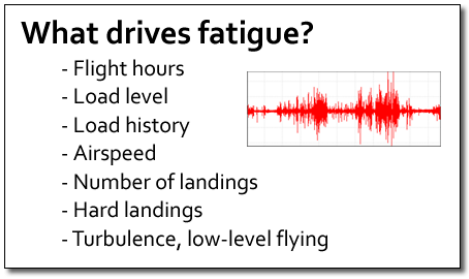
Airframe Trend Monitoring in General Aviation

Aircraft life varies with usage. Hours/landings/cycles don't tell the full story. Airframe Trend Monitoring (structural data recording plus analysis) can be used to assess the state of the structure and prevent problems before they happen. It flags safety issues, tailors maintenance to actual usage, offers design enhancements based on known operation, and provides insight into in-service events.

Importance for GA

General Aviation (GA) includes business, environmental, emergency, agricultural, health & medicine, transportation, media, and recreational. Given this diversity (and sheer volume of aircraft), GA represents the largest aviation category. It is also the most underserved (and under-monitored), in terms of the profound impact individual aircraft operation can have on safety and life assessment. GA aircraft (like civil and military) are designed to be "controllable and maneuverable during all flight phases" (takeoff, climb, level flight, etc.). They're designed to withstand "the maximum [and repeated] loads to be expected in service", all "without detectable cracks" and while avoiding "catastrophic failure due to fatigue … throughout the operational life of the airplane."[1] Regardless of the robust design methods used by manufacturers in compliance with these requirements, wouldn't a better solution be to actually know the specific usage of each airplane throughout its service life? Wouldn't this lead to a safer product, a better design, and a lighter airframe, all resulting in lower operating costs? Actual usage data removes uncertainty, minimizes conservatism, reduces risk, and improves safety.



Long understood in commercial and military aviation, this issue is only now gaining momentum in GA. The AOPA/AAA/EAA/FAA highlight the impact "special usage" (such as low-level flying, heavy loads, or short flights) has on the aircraft, causing "additional metal fatigue damage. … Severe usage early in an airplane's life is just as damaging as similar usage to an old airplane, [resulting] in a higher likelihood of cracking later in the airplane's life."[2] The August 2009 GA-Flight Data Monitoring (FDM) Conference focused on how to best capture this "special usage" and assess its impact on safety. It was shown that "applying best [flight data capture and analysis] practices offers the potential of having a significant impact [on accident reduction] within GA."[3]

The Solution

The solution is Airframe Trend Monitoring, wherein the state of the airframe is continuously measured and assessed for each flight to help maximize safety. This solution includes both hardware (low-cost, high-fidelity, high-sample rate data recorder) and software for post-flight analysis.

Benefits to GA

Accurate aircraft usage data benefits **owners/operators/charters** by reducing maintenance costs. Also, a recorded life history can impact sale/resale values (it removes unknowns). **Training schools** can have tools to visualize and assess their aircraft's usage. For **aircraft manufacturers**, more data provides more insight into how their aircraft are being operated in the field, reducing costs on future design by removing uncertainty (and conservatism) from the design equation. **Maintainers** gain greater insight into the operation of the aircraft they service. For everyone – a safer airplane.

About the Author

Chance McColl is the Director of Engineering (Marietta) for Technical Data Analysis, Inc. (TDA) and has significant experience in aircraft fatigue life assessments for the US Navy, NOAA, NASA, as well as a number of international military organizations. For more information, email cmccoll@tda-i.com or visit http://www.tda-i.com.

References on following page

[1] FAA; CFR, Title 14, FAR Parts 23.143, 23.301, 23.574.

[2] AOPA/AAA/EAA/FAA; “Best Practices Guide for Maintaining Aging General Aviation Airplanes;” Sep 2003.

[3] http://www.capacg.com/reference.html.