ALPAToolbox

Toolbox for Tinkickers

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ALPA's Engineering and Air Safety Department's accident investigation lab on the second floor of the union's Herndon, Va., building is a quiet workspace, in stark contrast with the destruction and tragedy memorialized in photos on the walls with captions detailing ALPA's participation in accident investigation over many years. Memorable events, known frequently only by flight numbers—Simmons 4184, Atlantic Southeast 529, Colgan 3407, USAir 1016, Aloha 243, TWA 800, FedEx 1406—frame ALPA's contribution to improving safety through painstaking analyses of data.

ALPA has recognized the safety value of data recorded in real-world operations for decades. Next to state-of-the art computer-driven flight path reconstruction work stations, ALPA's accident investigation lab proudly displays a relic of the beginnings of flight data recording and analysis—a roll of steel foil on which a stylus traced a record of the airplane's heading, altitude, airspeed, and vertical acceleration. A magnifying glass was the tool of choice for analysis. Such was the relatively primitive beginning of flight data recording, one that amazingly survived in North American airline operations into the 1980s.

Since that beginning, the technology to record and analyze data has advanced tremendously to the point where we now see the capability to obtain, store, and analyze hundreds of parameters captured many times each second for days of flight operations.

State-of-the-art tools

As technology evolved, the capabilities of ALPA's accident investigation lab have kept pace. The Association maintains sophisticated audio equipment to analyze ATC conversations, computer hardware and software to analyze both ATC radar data and digital flight data recorder (DFDR) data, and large-format printers for data plots, diagrams, and illustrating other results of analyses.

Chris Baum, a manager in ALPA's Engineering and Air Safety Department, explained, "ALPA's accident investigation lab has four major areas of capability—flight data analysis, flight path reconstruction, ATC radar track analysis, and ATC voice analysis. The lab and, more importantly, the ALPA staff engineers trained to use the equipment represent a resource available to support ALPA master executive council safety work.

"No other pilot association has these capabilities," Baum continued. "One of the strengths of ALPA is that we have the depth of resources to continue making use of the lab's capability no matter what else is going on. An ongoing investigation is top priority, but we can provide trained staff engineers to use the lab to support the investigation and provide full technical support to the ALPA team and still cover all of the other responsibilities we have.

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"The capability to perform in-depth analysis on behalf of ALPA members extends beyond accident and incident investigation," said Baum. "Aviation Safety Action Programs [ASAPs] have significantly reduced the number of certificate action cases, but ALPA attorneys still occasionally need Engineering and Air Safety Department technical support for an enforcement or disciplinary case. Since ASAP has become so prevalent, the number of cases has gone down, but the complexity of those not addressed through ASAP has gone up. With our depth of resources, though, we can take the time to dig deep—sometimes really deep—to make sure every angle is looked at and our members have the full benefit of the experience and technology we have."

Staff engineer Steve Serur, who has extensive background as an air traffic controller, offered this illustration. "A detailed, accurate transcript of pilot-controller communications can take as long as an hour per recorded minute of data," he explained. "With the sound analysis software we have, we can listen to even a brief exchange over and over, speed it up, slow it down, filter out background noise, and in the end develop a very clear record of what was actually said during a pilot's exchange with ATC, even on a busy, congested frequency. We can also use ALPA's ATC radar track analysis software to look at separation between aircraft, and even marry that up with the voice data to get a better picture of an event."

Baum continued, "Although we developed this capability primarily for investigations, we have seen benefit in using the lab's capability for safety training. The ability to quickly and accurately display data in a wide variety of ways—multiple plots, flight path animations overlaid on aeronautical charts, radar and voice together—can be a very powerful tool for illustrating the severity and/or complexity of an event. Looking at columns of figures and nothing else may be accurate, but that just doesn't have the same impact."

To be able to do that, ALPA has acquired state-of-the-art

PHOTOS BY CHRIS WEAVER

ALPA staff engineer John White (above) prints a data plot on a large-format printer while staff engineer Chris Heck (left) creates an animation from DFDR data.

software—the same as or similar to that used by major governments' aviation accident investigation organizations around the world—to conduct FDR analysis and flight path reconstruction with an "extremely high degree of fidelity on a par with industry leaders," noted Baum.

FDR data and flight path reconstruction

A flow chart on one wall of the lab shows how data are transferred and made available for analysis during an accident investigation. "Of course, it starts out as raw data—zeros and ones," said staff engineer Chris Heck. Then there's a lot of processing done by the NTSB or the Transportation Safety Board of Canada to turn that into aircraft-specific engineering units—knots, feet, degrees, psi, and so forth. "We don't routinely plot all the data just because we can," Heck added. "For example, if the landing gear was retracted throughout an event, there's no point in depicting that on the data plot. We're looking for changes, the sequence of events, the timing of those events, and rates of change."

A plot on display in the lab illustrates the point: For Simmons Flight 4184, an ATR 72 that crashed after suffering wing icing and rolling out of control, a single page depicting indicated airspeed, heading, wing angle of attack, pitch, prop rpm, engine torque, autopilot engage/disconnect, altitude, left aileron position, elevator position, and vertical g speaks volumes. "At the time of that accident, producing that kind of illustration would have taken a considerable amount of time. Any changes to it would mean that we had to start the whole process over," Baum added. "Now we have the capability to quickly and accurately depict exactly what is needed to support a concept that needs to be illustrated for the investigation, and just as quickly adapt it to the changing needs of the ALPA team."

Heck and senior staff engineer Chad Balentine are adept at using ALPA's animation software to create an animation of an accident or incident. However, they don't produce an animation for every accident or incident. While Heck and Balentine can develop a desired plot of pertinent parameters within a few minutes, creating an animation can require a few weeks of a staff engineer's time.

"We create animations primarily for presentations," Balentine said, "not primarily for analysis. We can show the primary flight instruments, yoke or stick position and movement, engine gauges, and rudder pedals along with the orientation of the airplane and the position of its control surfaces. It's a great tool, but we have to be careful that it's used correctly. The visual image can be very powerful, and people tend to look at it as a movie of the event. But it's still only as good as the data that are available and fed into it. "

Airline safety in North America has improved dramatically since the dawn of the civil jet age, and use of ALPA's accident investigation lab has changed accordingly. But ALPA staff engineers still use the sophisticated software and hardware at their disposal on a regular basis for incidents, for training, and for technical support they provide to ALPA's attorneys, all of which allows them to stay current and maintain the skills they need when the unwelcome call comes via the 24-hour ALPA accident/incident hotline (202-797-4180) in the middle of the night. Balentine summed it up, "The whole industry is moving away from relying on forensic investigation to 'solve' accidents that we've already had and toward using the massive amounts of data that are now available from line operations to do detailed analysis, identify potential safety problems, and prevent accidents."