Modernizing the A-10 loading spectrum development process

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In the early 2000's, the A-10 fleet transitioned away from the legacy MXU recorders that were becoming increasingly obsolete and toward a new recording solution. With this transition, the downstream tools used to process the new data also needed replacement. Four software tools were eventually developed, which performed the following functions: 1) processing the binary recorded data and reviewing each file for validity, 2) visualizing each flight by parameter (e.g., airspeed, altitude, accelerations, etc.) and assigning mission type, 3) counting maneuver occurrences by parameter and creating quarterly usage reports, and 4) calculating stresses at each of the fatigue critical locations and creating randomized stress sequences for input to damage tolerance analysis or test. Screenshots from the four programs can be seen in Figure 1.

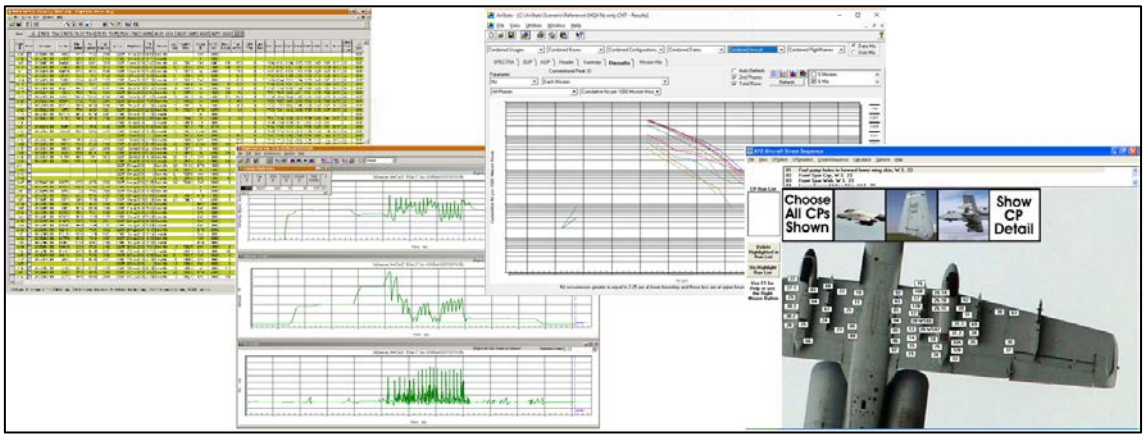

Figure 1. Software tools developed for A-10 flight data processing, maneuver spectra generation, and stress sequence development.

The initial focus for these software tools was to increase their flexibility and capability over the legacy programs in understanding the details of how the A-10 fleet was being flown. The programming structure, with many parameters and processing rules written into external files rather than being hard-coded into the program, has proven very beneficial to that end. This flexibility allowed for many valuable studies regarding issues such as relative severity across the fleet, gunfire rates, stores carried, landing speeds, etc., and how they impacted the structural integrity of the fleet. As an example, Figure 2 shows how the recorded sink rates at landing compared to the legacy assumptions, showing the landing gear and backing structure were not experiencing the severity of loading that was originally anticipated.

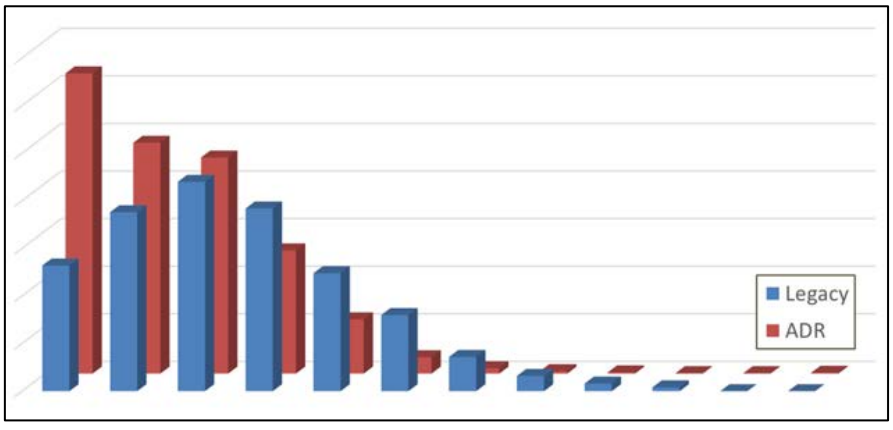

Figure 2. Histogram of landing sink rate design assumption (Legacy) and as recorded (ADR).

As the fleet flew with the new system, potential enhancements to the recorded data and the processing tools were continually being considered and incorporated. More parameters were read from other aircraft systems, including mission type, stores, and fuel information useful for calculating aircraft gross weight. The newly added information meant that it was no longer necessary for flight logs to be delivered with the flight data, simplifying the process for maintainers and improving the accuracy of the data. Other parameters such as flight control positions and over-g events expanded USAF visibility into the usage and the potential need for maintenance action.

After the new recorders had been flying on a subset of the fleet for a few years, the decision was made to install them on all remaining A-10s to not only benefit the quality and quantity of data going into the Loads/Environment Spectra Survey, but also to improve the Individual Aircraft Tracking Program, which by this point was dealing with obsolescence issues of its own. The order of magnitude increase in data to be processed led to the data processing and maneuver spectrum development functions being automated and transitioned to the Tinker AFB ASIMIS office. This has given the USAF even more flexibility and internal capability to gather usage data necessary for force management, responding to data requests, and handling fleet issues as they arise.

Keywords: Structural loads monitoring, Flight data recording, Stress sequence development