ASME TURBO EXPO 1988

GAS TURBINE CONFERENCE AND EXHIBITION— A PERSONAL VIEW

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Introduction

The programme for the American Society of Mechanical Engineers (ASME) conference (held in Amsterdam, 5–9 June, 1988) provided some 300 papers presented in a number of parallel sessions, together with a concurrent exhibition of gas turbine equipment and techniques.

Inevitably, against such a background, any one view of the conference will be significantly biased by the individual's particular interests. The difficulty is actually worse than is apparent at first sight as some programme slots had little of direct relevance while others had two or three parallel sessions, each with good papers.

Consequently, this personal view is presented with some diffidence and must be read as representing the author's interests rather than the overall theme of the conference. As with any such gathering, a major benefit was the presence of a large number of experts with a reasonable opportunity to meet outside the official conference hours and exchange information and ideas.

Notes on Papers of Particular Interest

Session 20—Military Engine Development—1

A paper on *The Future of the Military Aircraft Gas Turbine Engine* by B. Koff (Pratt and Whitney) gave a fairly bland review of the areas in which progress was likely to be made. However, in his description of the current F-100 engine, he described a significant building block for an engine management system. Pratt & Whitney have designed an engine trimming digital control which monitors the pressure difference across the engine. If this drops at a given operating point (indicating reduced efficiency) then fuelling is increased automatically to compensate. Eventually a temperature limit will be reached, when the engine will have to be removed for overhaul.

Session 33—New Approaches for Computational Methods

Real Time Simulators for use in the Design of Integrated Flight/Propulsion Controls by Davies, Jones and Noonan of Pratt and Whitney. Described their approach to integrated controls design, and the importance of simulation for initial validation of designs. Systems simulations used state variable models.

Multivariable Turbofan Engine Control for Full Flight Envelope Operation by Polley, Adibhatla and Hoffman of GE Aircraft Engines. A paper of general interest which described the GE design methodology for multivariable

controllers. Points made included design to cover the whole flight envelope rather than 1 or 2 design points, and the use of robustness criteria to examine controller stability.

Weibull Analysis Techniques on a Desktop Computer by Byers, Naval Air Development Center. This paper did not break any new ground technically but described quite a comprehensive set of Weibull analysis routines which were designed to be 'user-friendly' and tailored to run on IBM PCs and compatibles (written in compiled BASIC). Software is in use by Naval Air Depots, NAVAIR, NAPC Trenton, etc. and could be made available to others on request.

Session 48—Gas, Turbine Engine Diagnostics using Transient Data

It was interesting to note that a complete session was devoted to this topic whereas a year ago the idea of using transient data was met with widespread scepticism.

Fault Diagnosis of Gas Turbine Engine from Transient Data by Merrington of Aeronautical Research Laboratory, Melbourne. The F-18 fighters used by Australia have F-404 engines which have been designed for on-condition maintenance. However, the basic sensor fit is limited and ARL have used parameter estimation techniques to deduce the performance of parameters not measured directly, and hence to identify the condition of engine modules. The approach has been developed using simulation and initial validation carried out with a faulty exhaust temperature sensor fitted to an engine. It is planned to examine the effects of further faults both on simulation and engine. The work parallels the System Identification/Parameter Estimation studies undertaken for RAE(NED) by Cambridge Consultants Ltd., and collaboration is likely to be productive.

Transient Performance Trending for a Turbofan Engine by Henry and Moffatt (Canadian Forces). The study looked at ways of improving the quality of data collected by the standard Condition Monitoring system fitted on the CF-18 fighter. The study showed the care necessary to define 'windows' with adequate repeatability for transient trend analysis.

An Investigation of Component Deterioration in Gas Turbines using Transient Performance Simulation by M. F. White (Trondheim). A somewhat disappointing presentation which concentrated on the building blocks of a simple transient engine simulation. Investigation of simulated faults indicated that the time taken for acceleration between two loads was a sensitive parameter which was also easy to measure.

Recent Advances in Engine Health Management by Pipe and Fisher of Stewart Hughes Limited. The paper described the firm's work on gas path debris analysis and representational modelling; the techniques seem considerably in advance of anything presented by U.S. companies. An application of gas path debris analysis to marine gas turbines is being funded by MOD, and broader research programmes are being discussed by RAE(NED) and Stewart Hughes Ltd.

Session 72—Vibration Diagnostics and Measurement Technology

Helicopter Health Monitoring from Engine to Rotor by Marriott and Kaye of HSDE. The paper described the development of a helicopter health monitoring system which HSDE had developed in conjunction with Stewart Hughes. It was not clear exactly how the work was split, but the information display system was essentially that developed by Stewart Hughes where there is a graphic indication of a fault which guides the operator sequentially from the helicopter in the fleet which had a problem to the engine module where the fault is indicated.

The other papers in this session (from Bently Nevada and Southwest Research Institute) were both very disappointing and seemed about 10 years behind the times. Both, however, generated a lively discussion which perhaps indicates the position of the average user.

Session 86—Gas Turbine System Testing

Salt Ingestion Test of the AGT 1500 recuperated Automotive Gas Turbine by Bodman and Priore of NAVSSES. Described a re-test of the AGT 1500 engine fitted in the M-1 tank, at the request of the Marine Corps who were considering ordering the M-1 for marine use and wanted an assessment of the effect of the marine environment on engine life. A classic example of an imprecisely defined, minimum work necessary, test producing results of limited value where a little more care in defining objectives and test strategy would have provided a lot more useful information.

1000 Hour Qualification Test of the Textron Lycoming TF-40B Marine Gas Turbine Engine for the US Navy LCAC craft by Zoccoli of Textron Lycoming. LCAC = Landing Craft Air Cushion. A very open presentation of the results of MIL SPEC testing (modified to provide the higher salt levels of LCAC application)—the engine suffered from significant carbon erosion of the hot end. The paper described a very thorough analysis of the problem and combustor re-design, which further testing showed had eliminated the erosion problem. The revised combustor had a leaner primary zone (not unlike the RAE 'pepperpot' combustor). The second 1000 hour test had been stopped at 800 hours because of failure of a faulty combustor weld, but the carbon erosion problem appeared to be cured.

A New Approach to Evaluating the Inservice Performance of Marine Gas Turbine Air Filters by Hobday and Havill of RAE(NED), printed on pp. 424–437 of this issue.

Session 86 was the last of the symposium and consequently was somewhat sparsely attended. However, those who did attend took part in a lively discussion on all three papers, and there was certainly interest in the approach being outlined by RAE in this last paper, although it was accepted that a significant quantity of data would be required for its potential to be realized.
