Active Control of Combustion Pressures

CUSTOMERS

- **Reducing emissions of gas turbine engines at Honeywell**
- **dSPACE Prototyper supporting the control strategies**
- **ControlDesk for experiment control**

Honeywell Engines and Systems recently introduced an advanced technology program to reduce emissions from the Vericor line of gas turbine engines for industrial and marine applications. One of the key technologies being developed for this program is the active control of combustion pressure oscillations that are excited in gas-fired, low-emission combustion systems. The ability to reduce the risk of these pressure oscillations enables safe operation of the engine in regimes that minimize emissions. In the first phase of this program, the concept was developed and tested on the combustor of the engine in under a week using dSPACE Prototyper.

The control strategy is based on injecting fuel into the combustor using a high-speed valve as an actuator, while a pressure sensor is used to provide a feedback signal. The controller drives the valve so that fuel is injected into the system in such a way that the dynamic pressure oscillations are canceled. While only one sensor was used for pressure feedback, several additional pressure and flame sensors were used to analyze

Electronic control unit for industrial and marine engines.

the system dynamics, as shown in the illustration below. The first step in the development of the controller was to establish the optimal location of the valve and this was achieved via system identification. dSPACE Prototyper was used to drive the valve with various test signals and capture data from the sensors. The data was then analyzed using MATLAB, with the result that the best response could be obtained by modulating the fuel through the premixer. In the next step, several control strategies were implemented in the Simulink/RTI environment, and the dSPACE system provided a powerful method for rapid implementation and evaluation of these strategies. dSPACE Prototyper proved itself as a powerful processing platform, capable of handling both control and system monitoring functions at high sample rates. ControlDesk was used to tune parameters and monitor data during real-time operation.

The most successful controller produced a 75% reduction in the amplitude of 320-Hz oscillations and proved that active combustion control is an effective method of attenuating thermo-acoustic pressure oscillations. In the next phase of the project, the active combustion control system will be tested on a full-scale combustion rig and then on a complete gas turbine engine. The development team is planning to have a production-ready solution when the engine enters production in 2002.

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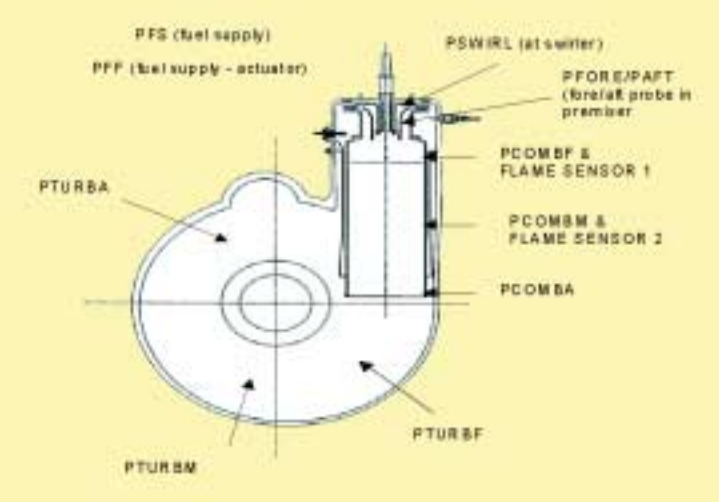
Software Versions on "Solutions for Control" Release 3.0

dSPACE software runs under Windows 95 / 98 / 2000 and NT 4.0.

- RTI 3.6 / 4.0
- ControlDesk 2.0
- MLIB/MTRACE 4.2
- RealMotion 1.1 (only Windows NT)

For more detailed information, please refer to *www.dspace.de*.



Test setup for active combustion control on ITG combustor rig.