COMPUTING FOR HIGH-FLYERS

Leon Liebenberg reports on state-of-the-art computer modelling processes being developed in South Africa to help improve the manufacture of stronger, safer blades for turbines used in commercial airliners.

For four years Professor Arnaud Malan has worked with new computer modelling simulation techniques to help manufacture aircraft turbine blades more efficiently. His simulations have produced information that will help reduce costs and improve the quality and strength of the blades.

When manufacturers make 'single-crystal' blades for turbines for the aeronautical industry, they make each one out of a single crystal, which they grow within a specially manufactured ceramic mould. The process by which the ceramic mould is dried is of paramount importance to the quality of the blade and the time it takes to manufacture. The drying times need to be kept short, while ensuring that the shell does not deform or crack in the process, otherwise the result is an ill-formed blade.

"We keep looking for ways to make the manufacturing process more efficient and at the same time to improve the quality of the turbine blades," says Malan. "Until recently we lacked the computational technology with which to successfully model the complex drying processes - which, in turn, would help us to fine-tune the drying time and improve blade quality."

Now, however, thanks to the software created by Malan and Professor Roland Lewis of the University of Wales-Swansea, it is possible to accurately model the process.

Lewis is a global leader in the field of computational fluid dynamics (CFD) technology, which is being used as the key technology in a related research and development project at one of the world's major aerospace turbine manufacturers. Lewis' earlier work on CFD codes gave Malan a starting point for simulating the drying process of the ceramic casts, a complex procedure which enables calculation of the best drying conditions (including the right temperatures and air flow).

Malan's contributions include improving on existing advanced numerical techniques, so the drying problem and surrounding fluid flow may be modelled effectively and accurately.

Programming techniques were also developed to enable the numerical technology to be transcribed into the high performance computer code needed for simulation purposes.
Malan's work stands to benefit high-tech aeronautical and materials industries worldwide which need to model the drying of complex materials. Preliminary benchmark applications range from the drying of construction materials to foodstuffs.

The software offers a very high degree of accuracy, and could help us to live healthier as well as safer lives.

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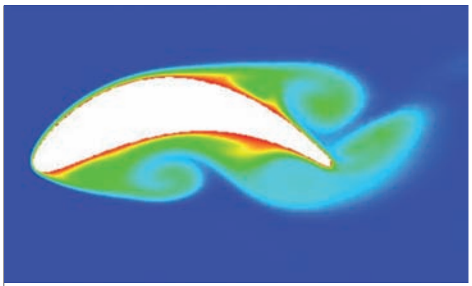

→ *Single-crystal blades used in the aerospace gas-turbine industry are cast in ceramic shells. The shell drying process is of paramount importance to the cost and structural integrity of the blade that is cast. The numerical modelling of this process not only enables streamlined production, but also helps to pinpoint shell regions that may impair the strength of the cast turbine blade and its ability to withstand stress. The figure shows the simulated moisture diffusion around a drying aerospace engine shell-mould. (Red denotes high moisture content, and dark blue denotes low moisture content).*