

# CFD analysis of rotating antenna

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In common with all electronic equipment, careful control of temperature within radars is essential for component reliability and performance. So, when British Aerospace came to design their new Sampson radar, they turned to AEA Technology and CFX to help in their understanding of the thermal behaviour of the system.

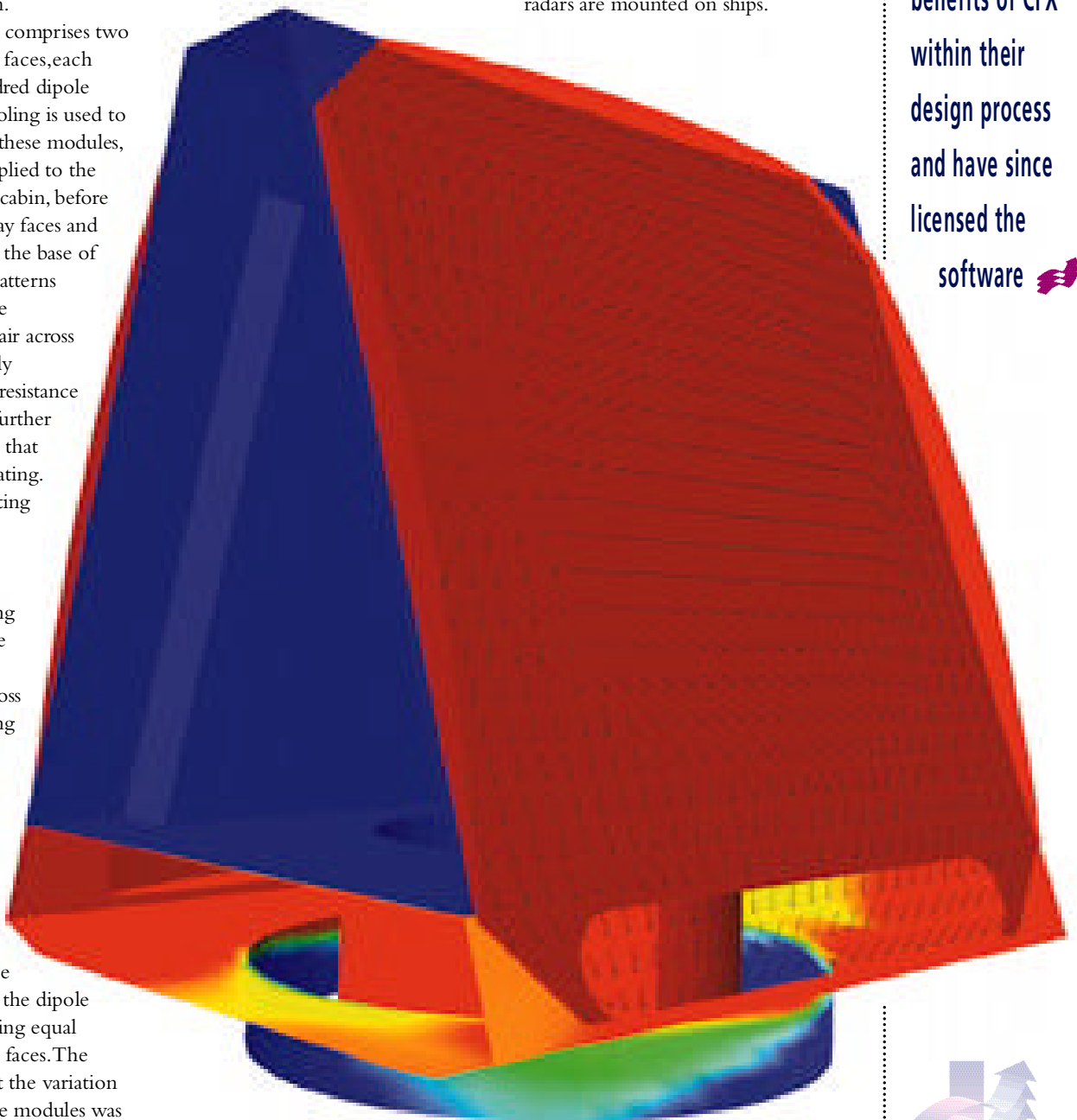
The Sampson radar comprises two opposing antenna array faces, each containing several hundred dipole modules. Forced-air cooling is used to dissipate the heat from these modules, with cool air being supplied to the interior of the antenna cabin, before passing through the array faces and exiting through slots in the base of the radome. The flow patterns within the radar and the distribution of cooling air across the array faces is strongly influenced by the flow resistance of the modules, and is further complicated by the fact that the whole system is rotating.

Rather than simulating each of the modules in detail, the CFX model represented their effect through resistances, using correlations which were derived from experimental pressure loss measurements. A rotating coordinate system was also used and revealed some interesting coriolis-driven secondary flows, both within the cabin and in the radar window (see figure). Ideally, the flow of air should be the same through all of the dipole modules, thereby ensuring equal cooling across the array faces. The simulations showed that the variation in mass flux through the modules was within -4% to +7% of the equivalent uniform mass flux, and that thermal performance was therefore perfectly

satisfactory. The CFX model also predicted the head loss through the system, which allowed British Aerospace to determine the fan characteristics necessary to deliver the required cooling flow.

Having started this project using CFX's consulting services, British Aerospace have recognised the

benefits of CFX within their design process and have since licensed the software. As well as continuing to use the radar cooling model which has been developed, British Aerospace are now also using CFX in areas such as aerodynamic loading calculations and predictions of heating due to the impingement of exhaust plumes when radars are mounted on ships.



Surface temperature on the radar structure and flow patterns within the radar window (with radome removed)

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