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Continued Study of the Error and Consistency of Fan CFD MRF Models

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The most common fan model to use in commercial CFD software today is the Multiple Reference Frame (MRF) model. This is at least valid for automotive under hood applications. Within the industry, for this typical application, this model is commonly known to under predict performance. This under prediction has been documented by the authors' of this paper in SAE paper 2009-01-0178 and VTMS paper 2009-01-3067. Furthermore has this been documented by S. Moreau from Valeo in "Numerical and Experimental Investigation of Rotor-Stator Interaction in Automotive Engine Cooling Fan Systems", ETC, 7th European Conference on Turbomachinery, 2007. In preceding papers a specific methodology of use has been documented and it has been shown that the MRF model under predicts performance for the airflow in a cooling system commonly with 14% in volumetric flow rate. This is for a system dominated by inertial effects. These 14% was shown to apply across fans of different sizes and designs hence illustrating a consistency of the fan model. In paper 2009-01-3067 a different methodology of use was documented which decreased the under prediction to 8%. In this paper the study has continued and is now presenting a more successful methodology of use which essentially removes the under prediction of the fan MRF model for most of fan operation, taking it for axial flow conditions within reasonable capabilities of reproducing tested geometry in a simulation environment, i.e. a difference of 0-1% between measurements and simulations.

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