Detailed geometrical information of aircraft fuel tanks incorporated into fuel system simulation models

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Fuel tanks in fighter aircraft have an irregular shape which is represented by a detailed CAD model. To simulate a fuel system with sufficient amount of detail to solve the design issues, necessary geometrical information need to be given in a compact and computationally fast form. A function approximation using radial basis functions is suggested, analyzed and compared to some other methods. The complete process from production scale CAD model to system simulation model is considered. The work has shown the following:

It is possible to achieve an appropriate level of accuracy for all intended design studies. It is important to get a sparse representation to keep the translation/compilation time down. Several different choices of radial basis functions are usable and the Gaussian is comparable to the others with respect to simulation time, but gives more sparse representations. Care is needed to avoid the Runge phenomenon, which may slow down simulations considerably when the fuel level is close to a pipe end. Finally, using RBF as function approximation keeps simulation times in the same level of magnitude as the simple and much less accurate 2D square box approximation previously used.

Keywords: aircraft design; fuel systems simulation; geometrical representation; surrogate model; radial basis functions.

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