Proceedings of CHT-17
ICHMT International Symposium on Advances in Computational Heat Transfer

May 28-June 1, 2017, Napoli, Italy

CHT-17-xxx

On the impact of reboosting manoeuvers in DCMIX1 experiments: Pure molecular diffusion of ternary liquid systems

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Thermodiffusion experiments involving ternary mixtures need to be conducted in microgravity environments, such as ISS (International Space Station), in order to avoid solutal convection. The characteristic time associated with diffusion are normally very large (of about dozens of hours), so that, experiments are potentially exposed to vibrating perturbations like reboostings, dockings and extra vehicular activities. To avoid this, the actual procedure is simply to stop the experiments when this kind of disturbances are active.

It is, therefore, mandatory to investigate in deep the problem in order to define, if possible, a reasonable safe interval for the intensity of the perturbations to redefine the actual and expensive procedure. To do this, a three-dimensional Finite Volume model has been implemented to study different real reboosting acceleration signals. The results obtained, have been compared with the 1D analytical solution for an initial linear distribution of concentration, which simulate the last pure molecular diffusion relaxation step of the DCMIX1 type ternary mixture in the ISS. In particular, we will try to answer if, under the present computational conditions, reboosting episodes are aggressive enough with this last step of the experiments and, consequently, if it will be mandatory to stop them during the activity periods. All these conclusions will be very illustrative for the modification -or not- of the different procedures associated with the operation of the experiment by the Earth personnel. As an example of the results, Figure 1 shows the difference in the concentration profile of component 1 of the ternary mixture along the diffusion cell between the theoretical analytical solution and the computational simulation during a reboost.

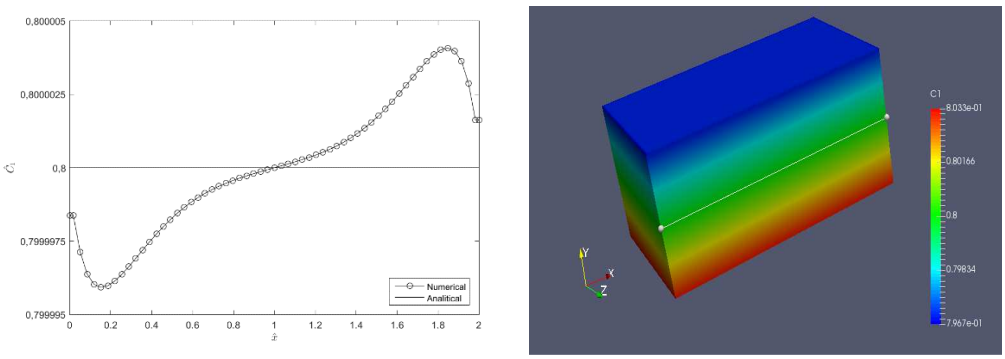

Fig 1: Left: Difference in the concentration profile of component 1 of the ternary mixture along the diffusion cell between the theoretical analytical solution and the computational simulation during a reboost, right: location of the line used to plot the concentration profile.