

Computer simulations of heat and fluid flow

Laszlo Fuchs
Division of Fluid Mechanics
Lund University
S-22100 Lund, Sweden

Fluid flow is characterized by non-linear effects. The most common one is turbulence which poses a real challenge for the simulation of practically all engineering problem. In principle, one could simulate all the details of the flow (Direct Numerical Simulations, DNS) if computer capacity is adequate. However, such simulations not only computationally are not always possible, but they are also meaningless! The sensitivity of the flow to perturbations in initial or boundary conditions implies that a single simulation has a meaning similar to a single frame taken out from a movie. When the flow involves freely moving solid objects or another immersed fluid, the flow may become chaotic even when the fluid flow itself is laminar. Even “simple” laminar flows can be rather complex, since even apparently simple flow problems may undergo sudden changes in the flow state (i.e. bifurcation) by introducing (explicitly or implicitly) an arbitrarily small perturbation. The presentation shall give examples of the simulation of such bifurcation problems and coupled systems that lead to either system lock-in effects or to fully chaotic motion. We shall also give some highlights of the methodology required for simulating such flow problems.