Abstract

In this thesis, we propose the association of Proper Generalized Decomposition method (PGD), meshless methods and Asymptotic Numerical Method (ANM) to solve linear and nonlinear transient problems. The PGD is a model reduction method that reduces the dimensionality of the physical problem by transforming the linear problem into a time dependent problem and a problem depending only on space variables. It consists in searching the solution of the problem in the form of a sum of couple of functions in space and time using an iterative method. For linear transient problems, we have associated PGD with meshless methods and in particular the fundamental solution method (MFS) and the moving least square method (MLS). The PGD then represents a new alternative for meshless methods community that generally use either the Laplace transform or a classical time discretization for the resolution of transient problems. Knowing that meshless methods based on a strong formulation reduce the computational time, our work is based on this approach. To show the effectiveness of this algorithm, we applied it to thermal and mechanical problems. The second part of this thesis consists in associating PGD and ANM to solve nonlinear transient problems. We have shown that to obtain the solution over large time intervals, a continuation technique is necessary. We have proposed two continuation strategies: « H-Continuation » which consists in solving the problem over the entire time interval by applying ANM incrementally and « T-Continuation » which consists of the use of time increments whose adaptive length is calculated from the terms of the series obtained by ANM.

Keywords: Nonlinear transient problems, Proper Generalized Decomposition, model reduction methods, meshless methods, Asymptotic Numerical Method, H-Continuation, T-Continuation, homotopy, Friction Stir Welding.