OBJECTIFS DU PROJET

Today, numerical simulation is widely employed in industry but the capabilities remain too far from the industrial ambitions. Many industries are confronted to very large and complex systems, involving couplings, strong non-linearities, different scales in space and time… whose solution must be performed many times if one is interested in any kind of optimization or inverse identification.

Numerical strategies reducing the computing time by many orders of magnitude is a real opportunity because it could make possible simulations never until now carried out, and obviously it could enlarge significantly the level of complexity of systems to be analyzed. On the other hand, important progresses could concern the real time simulations that require a drastic reduction of computing times.

Proper Generalized Decomposition allows (i) CPU time savings of several orders of magnitude is a real opportunity because it could make possible simulations never until now solved and that were considered unsolvable (iii) the transformation of many “standard” models into multidimensional ones allowing unimaginable possibilities.

MÉTHODOLOGIE ET RESULTATS

We summarize the main questions which are being addressed in this project:

The first point concerns the question of optimality of the separated representations. At present, separated representation are not optimal because they contain too many terms. We are comparing Galerkin approaches, the ones based on the residual minimization, and alternative constructors based on Petrov-Galerkin projections.

The second key point in the use of this kind of approach is related to the error estimation (a priori and a posteriori) and the definition of appropriate refining strategies.

The third issue concerns the treatment of parametric models in a large sense. These parameters could be material parameters, applied evolving loads, boundary or initial conditions, parameters defining the geometry where the domain is defined… By introducing all these parameters as extra-coordinates we could compute extremely general solutions from which optimization (also shape optimization), efficient inverse identification or real-time simulations could be easily performed.

The fourth issue concerns models involving localization in space or in time, and problems involving dynamics and waves.

Finally, the computational implementation addresses several specificities that should be addressed by defining a new algorithmic, compatible with the usual simulation platforms.

CONCLUSION ET PRESPECTIVES

Excellent progresses that leaded to the ANR Virtual Charts proposal (2013).