VIRTUAL CHART BASED DESIGN, INVERSE ANALYSIS AND CONTROL

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Abstract. Virtual chart constitutes an appealing tool for performing efficient design, real time simulations, efficient optimization, inverse analysis and control of systems and processes. When such charts are available, no more on-line simulation are needed, because everything reduces to a dialog between the designer or controller and the chart. The chart contains all the required information, that is, the solution of the physical model for each choice of the model parameters. These parameters can correspond to the applied loads, initial or boundary conditions, material or process parameters, parameters defining the geometry of the domain in which the model is defined, ... The main difficulty related to the construction of such a chart lies in the fact that the parametric space must be accurately explored in order to define an accurate chart. When the number of parameters increases, the sampling of such high-dimensional parametric space becomes unaffordable when standard discretization techniques apply for each possible scenario. Model order reduction makes possible the off-line construction of virtual charts in two ways. First, by constructing an adaptive reduced basis, from which the solution of each direct problem can be performed very fast, reaching several order of magnitude of CPU time savings. Second, by introducing the parameters as extra-coordinates and then addressing the solution of the resulting multidimensional problem by invoking the PGD, one can have access to the solution of innumerable scenarios, all those represented by the discretization of the extra-coordinates related of the model parameters. Again the question of adaptivity is crucial. From these virtual charts, simulation, optimization, inverse analysis, control, ... can be performed on-line, many times in real time and by using light computing devices like smartphones or tablets.