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An efficient mCRE-DDM based approach for model updating in structural dynamics with industrial applications

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The modified constitutive relation error (mCRE) has been widely used for validating and updating numerical models in structural mechanics [1], since it offers some advantageous properties such as convexity, modeling error localization and robustness to noisy measurements. Inverse problems based on this functional are classically solved using a two-step iterative process. Each iteration begins with a step of localization of erroneous regions of the structure, followed by a correction step of concerned parameters. The localization step consists of solving a large system of equations which needs to be reassembled after each correction step, since the underlying parameters of the system change. This implies an important computational time which represents a real bottleneck of the mCRE based methods and make them less convenient for problems of industrial size.

To overcome this problem, we propose an approach based on domain decomposition techniques [2] which are suited to the mCRE localisation step. Our approach benefits from the same advantages of DDM methods such as parallelization which allows dealing with large problems in a reasonable computational time. Moreover, the correction step can be performed in parallel for independent subdomains and only those with changed parameters need to reassemble their part of the problem. We also noticed that the iteration count to solve the localization step decreases drastically when the solution from the previous mCRE iteration is used as initialization. Besides these numerical advantages, the new approach allows changing a local subdomain model easily which makes it more flexible.

In this context, we develop a dual variant of the approach inspired by the classical FETI method. Adapted preconditioners are also proposed. The approach is implemented in an industrial software, it will be illustrated and performance will be evaluated on several numerical experiments.

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