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PSEUDO DNS METHOD AS A NATURAL STABILIZATION TECHNIQUE FOR UNSTEADY ADVECTION REACTION DIFFUSION PROBLEMS

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Abstract. It is well known he usefulness of solving problems numerically from well posed mathematical models. However some features should be warranted, like stability, consistency, conservativity, precision and, if possible, working as much efficiently as posible. Many of these problems arise as advective, diffusive, reactive systems in both steady and transient states. Due to the known drawbacks in solving these problems, many proposals to stabilize them have arisen, most losing something in the order of accuracy, for which a linear scalar version of the problem has been developed for such a challenge. Most of them need parameters that are normally ad-hoc chosen inspired by a mix of physics, mathematics and empirism. In this work we propose to apply the pseudo DNS method, a multiscale technique developed in our group previously for incompressible turbulent flows, and now applied to physically stable systems, like unsteady advection, diffusion and reaction, in order to maintain the second order of precision both in the space as in time in a numerically stabilized way. After having achieved a very promising result in the steady 1D case where numerically exact solutions can be achieved and after having started the extension process to the steady 2D / 3D case with encouraging results, in this work we intend to reinforce what was obtained for the 1D case , but now in an unsteady condition with solutions that converge to second order in a stable parameter-free form, simply by appealing to solutions solved previously (for example off-line) for the scales not represented in the discretization. In addition to having good stabilization and precision properties, good efficiency is added. Will this be the way to close a line of research in which humanity has been involved for a long time with a simple, precise, robust and inexpensive way? Although a positive answer to this question cannot be affirmed, the results that are presented augur some hope of achieving it.