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SOME PROGRESS IN THE DISCRETIZATION OF CONVECTION DIFFUSION EQUATIONS WITH ARBITRARY COEFFICIENTS AND SOURCE TO REACH MACHINE ACCURACY

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This paper explores new ways of determining the coefficients that link nodal values in a convection diffusion equation in order to provide an exact discretization. Instead of relying on approximating the derivatives of the differential equation the method is based on the exact integral solution of a first order differential equation derived from the original convection diffusion equation.

The problem of obtaining the algebraic coefficients is related to the numerical evaluation of some integrals that appear in the exact solution of the ODE along a coordinate that contains the derivatives in the other coordinates as source terms. Some improvements for high Péclet number cases that build upon schemes already presented in previous Congresses will be described. The asymptotic behaviour of the coefficients in the limit of Péclet number going to infinity will be discussed. It will be shown that the new approach is consistent with the asymptotic values and provide results near machine accuracy for as few as one hundred nodes in some cases.

Some application examples will be presented to back up this approach. One of them is the Burger´s equation with arbitrary source for which, depending on the Péclet number based on the domain length, can get a machine accurate solution with few nodes (less than 100).