11th. World Congress on Computational Mechanics (WCCM2014)
5th. European Conference on Computational Mechanics (ECCM V)
6th. European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

Dynamical Systems approaches in Fluid Mechanics

J. Sánchez Umbría*, M. Net* and D. Puigjaner†

* Universitat Politècnica de Catalunya
Dept. of Applied Physics, Mòdul B4, Jordi Girona Salgado 1-3, 08034 Barcelona
E-mail: Juan.J.Sanchez@upc.edu, Marta.Net@upc.edu

† Universitat Rovira i Virgili
Dept. d'Enginyeria Informàtica i Matemàtiques, Avda. Pïsos Catalans 26, 43007 Tarragona
E-mail: dolors.puigjaner@urv.cat

Key words: Systems, Invariant Manifolds, Continuation and Bifurcation Methods, Fluid Mechanics, Weak Turbulence, Numerical Tools.

ABSTRACT

The recent developent of techniques to compute invariant manifolds, others than just fixed points, is helping to understand the transition between the solutions of a given problem and to weak turbulence. Several classical problems in Fluid Mechanics have benefited from this approach, plane Couette flow, pipe flow, convection in a cube or in rotating spherical shells, etc. (see [1,2] and references therein).

The techniques to compute the invariant manifolds (periodic orbits, invariant tori, homo and heteroclinic connections, unstable manifolds of periodic orbits, etc.) are based on Newton-Krylov methods applied to generalized Poincaré maps, which require accurate time integrations of the system defining the problem and the first variational equations. The study of their stability requires subspace iteration or Arnoldi methods to obtain the leading spectrum [3].

Tha aim of the minisimposium is to bring together researchers developing the techniques and numerical software for large scale problems (numerical linear algebra, time integrators, etc.) and those applying them to specific problems, in order to share ideas, identify new needs, and to promote collaboration between groups.

REFERENCES

[1] G. Kawahara, M. Ulhman, L. van Veen, "The significance of simple invariant solutions in turbulent flows", Annu. Rev. Fluid Mech., Vol. **44**, pp. 203–225, (2012).

[2] B. Eckhardt, T.M. Schneider, B. Hof, J. Westerweel, "Turbulence transition in pipe flow", Annu. Rev. Fluid Mech., Vol. **39**, pp. 447–2468, (2007).

[3] J. Sánchez, M. Net, C. Simó, Computation of invariant tori by Newton-Krylov methods in large-scale dissipative systems h, Physica D., Vol. **239**, pp.123–133, (2010).