Part B.2 Proposed future research for the group (2007-2010)

(To be completed by the Principal Investigator on behalf of the group. DO NOT complete this part if the Research Group has moved to a different Unit)

1. Principle Investigator (public key)

Delfim F. M. Torres
Public key: J001957OH25

2. Objectives (3000 ca)

The main objectives of the Control Theory Group (cotg) for the period 2007-2010 are: to obtain optimal synthesis for control-affine problems with non-commutative vector fields; to establish asymptotic properties for the approximation of generalized solutions of singular optimal control problems; to establish existence and Lispchitzian regularity of optimal trajectories for higher-order autonomous problems of the calculus of variations and for nonlinear control problems with various types of generalized controls; to study the problem of the choice of optimal reinsurance contracts under various performance criteria and risk structures; to study Newton's problem in classes of non-convex axially symmetric bodies; to do a numerical and analytical study of minimization or maximization of Newton-like resistance problems; development of the theory on the wave (quantum) analogue of the minimal resistance problem; to reformulate in the non-standard way the problem and solutions concerning optimal resistance for rough bodies and constructing explicitly solutions; to develop non-standard techniques on critical point theory, finite or infinite dimensional differentiation and manifold theory; to derive optimality conditions for the control of nonlinear dead oil problems; to study the convergence of recent numerical methods for the thermistor problem, as well as to define and study the existence of a new notion of entropic solution; to use our previous results on the computation of variational symmetries and the notion of abnormality to obtain more rich symmetries for ordinary differential equations; to obtain necessary optimality conditions for problems of the calculus of variations with higher-order Hilger (delta) derivatives; deriving optimality conditions for constrained variational problems over time scales; to prove a Noether's theorem with both "energy" and "momentum" terms in a general time scale; generalize our previous results on the fractional calculus of variations to higher-order fractional problems; to introduce a good notion of first integral for the recent non-differentiable variational quantum calculus of Jacky Cresson; prove necessary and sufficient conditions for an optimal control functional to be nonessential; develop effective tools for determining nonessential objectives in vector-valued optimal control problems; to study multiobjective Monge-Kantorovich optimal mass transfer problems.

3. Other researchers (PhD) involved (Public key)

Alexander Plakhov (J019647V383)
Evgeny Lakshtanov (J0225464T0Y)
João Pedro Cruz (J024738XS9R)
Manuel Guerra (J02465926JU)
Moulay Rchid Sidi Ammi (J021763HKS)
Natália Martins (J024046TXWTQ)
Vítor Neves (J02203245U0)

4. Funding, source, dates (1500 ca) (Indicate in full including amount of current and pending

funding)

5. Previous publications in the area (1500 ca) (5 in the last 5 years. If available you must indicate at the end of the citation, impact factor of the Journal (IP=..) and number of citations (nºC=…). Give title and full citation in original language)

2007

G. S. F. Frederico, D. F. M. Torres.
A Formulation of Noether's Theorem for Fractional Problems of the Calculus of Variations.
J. Math. Anal. Appl. (Available 16 Jan 2007) doi:10.1016/j.jmaa.2007.01.013
IP=[0.458 (2002); 0.473 (2003); 0.490 (2004); 0.579 (2005)]

M. Guerra, M. De Lourdes Centeno.
Optimal reinsurance policy: The adjustment coefficient and the expected utility criteria.
Insur. Math. Econ. (Available 1 March 2007) doi:10.1016/j.insmatheco.2007.02.008
IP=[0.606 (2002) 0.614 (2003) 0.602 (2004)]

M. R. Sidi Ammi, D. F. M. Torres.
Necessary Optimality Conditions for a Dead Oil Isotherm Optimal Control Problem.
J. Optim. Theory Appl. Vol.134, No.2, Aug. 2007 (in press).
IP=[0.402 (2002); 0.583 (2003); 0.593 (2004)]

2006

A. I. Aleksenko, W. de Roeck, E. L. Lakshtanov.
Note on the transport cross-section.
J. Phys. A: Math. Gen. V.39, 2006: 1-5.
IP=[1.406 (2002); 1.357 (2003); 1.504 (2004)]

E. L. Lakshtanov, S. A. Pirogov, A. I. Aleksenko,
One- and two-particle bound states in the Landau quantum liquid model.
Lett. Math. Phys. V.77 (1), 2006: 83-98.
IP=[0.812 (2002); 0.709 (2003); 0.926 (2004)]

2005

A. Yu. Plakhov, D. F. M. Torres.
Newton's aerodynamic problem in media of chaotically moving particles.
Sb. Math. Vol.196 (2005), No.6, 885-933.
IP=[0.419 (2002); 0.353 (2003); 0.453 (2004)]

2004

D. F. M. Torres.
Proper Extensions of Noether's Symmetry Theorem for Nonsmooth Extremals of the Calculus of Variations.
Commun. Pure Appl. Anal. Vol.3, No.3, 2004, 491-500.
IP=[0.581 (2003); 0.618 (2004)]

6. Special requirements (1500) (Equipment, facilities, staff or other especial needs essential to carry out the future research program)

Staff:

We require **support for a 1 year researcher** (with PhD) to work with
us in Aveiro in the area of multiple criteria optimal control,
with the objective **to design and implement a computer-based system**
to support a user in achieving a higher effectiveness of decision making
while solving multiobjective optimal control problems. More
precisely, the aim is to put in practice our theoretical results
on the conditions (necessary and sufficient) under which an
objective is nonessential/redundant in a given multiobjective

optimal control problem. **The software to be developed** will permit to identify nonessential and/or redundant objectives, thus obtaining control problems with a smaller number of objectives, which can then be solved more easily.

Equipment:

For the tasks mentioned in the previous item (Staff), we require support for (i) **one Personal Computer**, (ii) plus the necessary **licences for software development**: Maple 11 and the Global Optimization Toolbox for Maple.