Philippe Chartier
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Senior Researcher at INRIA

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Personal Information

44 years old
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Education and Employment History

Since 2003	Senior Researcher at INRIA. Scientific leader of the INRIA team IPSO.
2000	Habilitation Thesis in Mathematics, University of Rennes I, January 2000, *"Numerical methods for ordinary differential equations and differential-algebraic equations with application to hamiltonian systems"*.
1994-2003	Junior Researcher at INRIA.
1993-1994	Post-doctoral fellow, University of Auckland, department of mathematics.
1990-1993	PhD Thesis (grant CIFRE-SIMULOG) in Computer Science, University of Rennes I, "*Parallelism in the numerical solution of initial value problems for ODEs and DAEs*". Supervisors : B. Philippe and M. Crouzeix.
1989-1990	Military service as engineer at SIMULOG (Groupe Astek)
1988-1989	Master 2 of Numerical Analysis, University of Paris VI (with disctinction).
1986-1989	École Centrale Paris.
1984-1986	Preparatory classes at lycée Henri Poncaré, Nancy.
1984	Baccalauréat série C.

Research Interests

Analysis, conception and implementation of numerical methods for

- ordinary differential equations,
- differential-algebraic equations,
- hamiltonian systems,
- Hamilton-Jacobi-Bellman equations,
- parabolic partial-differential equations.

Project management

- 2009-2012 : Co-supervisor (with T. Lelièvre) of the ANR (National Agency of Research) project MEGAS : "Geometric methods and sampling : Application to Molecular Simulation".
- 2009-2010 : Co-supervisor of the ARC project VITELBIO (VIrtual TELluric BIOreactors)
- 2008-2011 : French coordinator of the PICASSO project PHC with the University of the Basque Country and the universities of Castellon, Valence and Valladolid.
- 2008-2010 : Co-supervisor (20%) with E. Faou (80%) of the INRIA associated team MIMOL *Molecular dynamics and molecular simulation*, in collaboration with the University of Tübingen and the University of the Basque Country.
- 2003- : Scientific leader of the INRIA team INRIA IPSO. IPSO is a joint team between INRIA, ENS CACHAN-BRUZ and the University of Rennes I. It is devoted to geometric numerical inetgation of ODEs and PDEs. It is now composed of six permanent members : F. Castella, P. Chartier, M. Crouzeix, A. Debussche, E. Faou, F. Méhats.
- 2006-2009 : Supervisor of the ANR project Ingemol, devoted to numerical methods in molecular simulation. The Ingemol project included the following persons and institutions :
  - F. Castella, P. Chartier, M. Crouzeix, G. Dujardin, E. Faou, G. Vilmart : IPSO
  - Ch. Chipot : CNRS, Nancy.
  - S. Descombes : ENS LYON.
  - E. Cancès, C. Le Bris, F. Legoll, T. Lelièvre, G. Stoltz : CERMICS, ENPC, Marne-la-Vallée.

Scientific committees

- SciCADE 2011, Torronto, Canada, july 11-15, 2011 (Member of the Scientific Committee).
- INRIA Evaluation Seminar of Theme 1, march 2009 (Scientific Organizer).
- SciCADE 2009, Beijing (Member of the Scientific Committee).
- SciCADE 2007, Saint-Malo (**Chair** of the Scientific Committee).
- Workshop in honnor of M. Crouzeix, CANUM 2006 (Member of the Scientific Committee).
- Meeting *"Sparse matrices and differential equations"* 1999 (Member of the Scientific Committee).

Editorial boards

- Invited co-editor in chief (with Linda Petzold) of the special issue of *Mathematical Modelling and Numerical Analysis*, Numerical ODEs today, Vol. 43 / 4 - July-August 2009, M2AN (Preface).
- Member of the editorial board of ESAIM : Proceedings (since January 2008).
- Member of the editorial board of Mathematical Modelling and Numerical Analysis (since January 2007).
- Invited co-editor in chief (with Bernard Philippe) of the special issue "Sparse Matrices and Differental Equations in Industry" of *Numerical Algorithms*, Volume 24, Number 4, 2000.

Prize

- September 2009 : "Honorary Fellowship" of the European Society of Computational Methods in Sciences and Engineering

PhD Supervision

- Co-supervisor of S. Wang, with A. Murua, since september 2009.
  Subject : "Splitting methods for the solution of highly-oscillatory differential equations".
- Co-supervisor of G. Vilmart, with E. Hairer, thesis in co-tutelle with the University of Geneva, 2005-2008.
  Subject : "Numerical methods for the rigid body problem".

– Participation to the supervision of S. Rault, thesis co-supervised by J. Erhel and B. Philippe, 1995-1998.
Subject : "Numerical simulation of satellite trajectories".
– Supervisor of A. Aubry, jointly with M. Crouzeix.
1994-1997.
Subject : "Runge-Kutta methods for index-2 DAEs and hamiltonian systems".
– Supervisor of E. Lapôtre, jointly with M. Crouzeix, 1998-2000
Subject : "Symmetric B-series"

Master theses supervision

– 2009 : V. Maheshwari, Indian Institute of Technology Delhi, 3 months,
Subject : "Study of the modified equation obtained by stroboscopic averaging for the Fermi-Pasta-Ulam problem".
– 2003-2005 : G. Vilmart, E.N.S. Cachan, 3 months,
Subject : "Trees, B-series, Hopf algebras, continuous iteration of formal series."
– 2001-2002 : M. Farah, M.Sc. student, 2 months,
Subject : "Reconstruction of a numerical flow and application to image processing".
– 1997-1998 : G. Vial, E.N.S. Cachan, 2 months,
Subject : "Interval Methods for ODEs"
– 1996-1997 : Q. Zou, 3 months,
Subject : "Implementation in FORTRAN of singly-implicit Runge-Kutta methods ESIRK".
– 1995-1996 : L. Winter, INSA Rouen, 3 months,
Subject : "Implementation FORTRAN on a parallel machine (KSR) of DIMSIM methods".
– 1994-1995 : A. Aubry, University of Rennes I, 3 months,
Subject : "Automatic generation of order conditions using MAPLE".
– 1991-1992 : P.M. Cutzach, University of Rennes I, 2 months,
Subject : "Implementation in FORTRAN on a parallel machine (INTEL IPSC2) of various ODE solvers".

Teaching

– 2009-2011 : Lecturer at ENS Cachan-Bruz, Licence 3, "Ordinary differential equations".
– 2009-2011 : Assistant in mathematics ("colleur"), Mathématiques Spéciales, Lycée Chateaubriant, Rennes.
– 2005-2009 : Assistant in mathematics ("colleur"), Mathématiques Supérieures, Lycée Chateaubriant, Rennes.
– Juin 2003 : Lecturer at the University of Rennes I, Master 2, *"Symplectic integration of integrable hamiltonian systems and long-time behaviour"*.
– 2001-2003 : Lecturer at the University of Rennes I, Master 1, "Hyperbolic systems, Laplace and Schrödinger equations".
– 1995-1998 : Lecturer at the Ecole Centrale Paris, Master 2, "Parallel numerical methods for ODEs" .
– 1992-1994 : Assistant in mathematics ("colleur"), Mathématiques Supérieures, Lycée Chateaubriant, Rennes.

Lectures to general audiences

– Summer School CEA-EDF-INRIA
"Simulation of hybrid dynamical systems and applications to molecular dynamics", IHP-Paris, 27-30 septembre, 2010.
– Formation Inspecteurs Principaux Régionaux, "Numerical modelisation of physical phenomena", October 2008, ENS Cachan Antenne de Bretagne.
– School UNESCO-TLEMCEN, "Mathematical models for water flows and water refining" , May

2008, Tlemcen (Algeria).
- Summer School CEA-EDF-INRIA, "Optimal control : algorithms and applications", May-June 2007.
- Winter School "Mathematical methods for molecular simulation", C.I.R.M., Luminy (France), January 2006.
- Winter School GO++ "Numerical methods for Hamilton-Jacobi-Bellman equations", Rocquencourt, 9-12 Décembre 2002.
- Winter School CEA-EDF-INRIA, "Numerical methods for atomistic simulation : from micro to meso", November, 2001.

Invitations at international conferences

- FOCM'11, Budapest, Hungary, July 4-6, 2011.
- Workshop KAM Theory and geometric integrators, Banff, Canada, June 5-10, 2011.
- Meeting on Geometric Numerical Integration, Oberwolfach, March 20-26, 2011.
- Congreso de la Real Sociedad Matematica Espanola, special session "Numerical integrators for Hamiltonian systems and related problems", Avila, February 1-5, 2011.
- Workshop DANCE on Dynamics, Attractors and Nonlinearities, Calatayud, November 4-6, 2010.
- IMAC Workshop on Splitting methods for differential equations, Castellon, September 6-8, 2010.
- Workshop on Combinatorics and Control, Madrid (CSIC), April 6-9, 2010, **(plenary talk)**.
- Seventh International Conference of Numerical Analysis and Applied Mathematics 2009 (ICNAAM 2009), Crete, September 17-23, 2009 **(plenary talk)**.
- SciCADE 2009, Beijing.
- IMA Annual Program Year Workshop, "Chemical Dynamics : Challenges and Approaches", January 12-16, 2009
- Workshop "Numerical methods and Hopf algebras of trees", Clermont-Ferrand, October 23-24, 2008.
- Workshop "Structure preserving schemes for evolution equations", E.N.S. Lyon, November 8-10, 2006.
- Conference on Geometric Integration, Castellón, Spain, September 18-22, 2006.
- Workshop "Geometric Numerical Integration", Mathematisches Forschungsinstitut Oberwolfach, Germany, March 19-25, 2006.
- Workshop Molecular Simulation organized by Claude Le Bris, ENPC, 2005.
- Workshop MULTIMATorganized by Grégoire Allaire, IHP, 2005.
- SciCADE'05 Conference, Nagoya, Japon, May 2005.
- SciCADE'03 Conference, Trondheim, Norway, July 2003.
- SciCADE Conference, Vancouver, Canada, July 2001.
- National Research Symposium on Geometric Integration, Melbourne, Australia, December 10-16, 2000.
- NUMDIFF-9, Halle, Germany, September 2000 **(plenany talk)**.
- SciCADE'01 Conference, Queensland, Australia, August 9-13, 1999.
- Anode Conference, Auckland, New-Zealand, July 1998.
- Workshop on Numerical Methods, Beirut, Liban, Mars 1998 **(plenany talk)**.
- SciCADE Conference, Stanford, California, USA, May 27-30, 1995.
- 15^{th} IMACS World Congress, Berlin, Germany, August 25-30, 1997.

Invited visits

- 2010 : may, 2 weeks, University of the Basque Country, collaboration with A. Murua.
- 2009 : november, 1 week, University of the Basque Country, collaboration with A. Murua.
- 2009 : november, 1 week, University of Tübingen, collaboration with Chr. Lubich.
- 2009 : march, 1 week, University of Valladolid, collaboration with J.M. Sanz-Serna.

– 2008 : february-december, 5 weeks, University of the Basque Country, collaboration with A. Murua.
– 2007 : november, 1 week, University of Geneva, collaboration with E. Hairer and G. Wanner.
– 2007 : october, 2 weeks, University of the Basque Country, collaboration with A. Murua.
– 2007 : january, 1 week, Isaac Newton Institute, Cambridge, collaboration with A. Iserles.
– 2006 : june, 1 week, University of the Basque Country, collaboration with A. Murua.
– 2006 : september, 1 week, University of Geneva, collaboration with E. Hairer and G. Wanner.
– 2004 : july, 1 week, University of the Basque Country, collaboration with A. Murua.
– 2001 : march, 4 weeks, University of Geneva, collaboration with E. Hairer and G. Wanner.
– 2000 : may, 1 week, University of Tübingen, collaboration with Chr. Lubich.
– 1996 : 8 weeks, University of Geneva, collaboration with E. Hairer and G. Wanner.
– 1996 : 2 weeks, University of Arizona, Tempe, collaboration with Z. Jackiewicz and J.C. Butcher.
– 1993-1994 : 10 months, University of Auckland, collaboration with J.C. Butcher, INRIA grant.
– 1992 : 6 weeks, CWI, Amsterdam, collaboration with B.P. Sommeijer and P.J. van der Houwen.

Regular Collaborators

– Ander Murua, University of the Basque Country, Spain : we have co-authored 7 papers. Most of our common work is devoted to algebraic structures encountered in the numerical analysis of ODEs and aims at characterizing with the help of trees certain geometric properties of integrators (preservation of energy, of quadratic invariants, of volume form...). It uses recent developments in algebra (in particular the connection between Hopf algebras and trees).

– Ernst Hairer, University of Geneva, Suisse : we have co-supervised the thesis of Gilles Vilmart 2005-2008, and co-authored 3 papers related to the *substitution law* and its applications. In addition, we had many more informal discussions during cross-visits since 1994.

– Claude Le Bris and Frédéric Legoll, CERMIS-ENPC : since 2003, we have been involved in various joint projects around molecular simulation (ARC Prestissimo (2003-2004), ACI Nouvelles Interfaces des Mathématiques (2004-2007), ANR Ingémol (2006-2009)) and we have co-authored 2 articles [21,23].

Thematic Mobility

– Parallel numerical methods for ODEs (1990-1998)
– Numerical methods for DAEs (1992-2002)
– Geometric numerical methods with application to molecular dynamics and laser-waves propagation (2000-)
– Algebraic structures in numerical analysis (2004-)
– Splitting methods for ODEs and PDEs (2008-).

Responsabilities within INRIA

– 2010 : Member of the committee in charge of the "prime d'excellence scientifique INRIA"
– 2009 : Member of the committee for the recruitment of Senior Researchers at INRIA
– 2009 : Member of the committee for the recruitment of Junior Researchers at INRIA-Rocquencourt.
– 2008- : Board member of the team-projects committee within the research unit of INRIA-Rennes.
– 2008-2011 : Elected Member of the INRIA Evaluation Committee
– 2008 : Member of the committee for the recruitment of Junior Researchers at INRIA-Rennes.
– 2007 : Member of the committee for the recruitment of Junior Researchers at INRIA-Rennes.
– 2006-2009 : Head of ANR project Ingemol.
– 2003- : Team leader of IPSO.

- 2004-2007 : Member of the Committee of Scientific and Technologic Orientation (COST) at INRIA in charge of the Prospective.
- 2001 : Member of the committee for the recruitment of Junior Researchers at INRIA-Sophia-Antipolis.
- 2000, 2001 : Member of the committee for the recruitment of Junior Researchers at INRIA-Rennes.
- 1999, 2000 : Member of the committee for the recruitment of Junior Researchers at INRIA-Grenoble.
- 1999-2002 : Elected Member of the INRIA Evaluation Committee
- 1999-2002 : Member of the team-projects committee within the research unit of INRIA-Rennes.
- 1999 : Member of the committee for the recruitment of Junior Researchers at INRIA-Nancy.

Organisation of conferences, workshops, and mini-symposia

- January 2011 : Co-organizer (with F. Méhats and M. Lemou) of the workshop "Numerical methods for stiff problems in Hamiltonian systems and kinetic equations", Dinard, 2011.
- January 2010 : Organiser of the workshop "Numerical methods for Highly-oscillatory ODEs and PDEs", Dinard 2010.
- June 2009 : Co-organizer (with A. Murua) of the Mini-Symposium "Algebraic tools in the numerical analysis of ODEs", Conference on Scientific Computing, Geneva 2009.
- May 2009 : Co-organizer (with H. Munthe-Kaas) of the Mini-Symposium "B-series and Butcher trees", SciCADE 2009, Beijing.
- March 2009 : Organizer (scientific) of the INRIA evaluation seminar (Theme 1).
- July 2007 : Main organizer of the international conference SciCADE 2007, Saint-Malo.
- May 2006 : Organizer of the Mini-Symposium "Molecular Simulation", CANUM 2006.
- March 1999 : Co-organizer (with B. Philippe) of the meeting *"Sparse matrices and ODEs"*.

Papers published in international journals

1. P. Chartier et B. Philippe, Computing, Vol. 51, 1993,
   A Parallel Shooting Technique for Solving Dissipative ODE's.
2. P. Chartier, SIAM Journal on Numerical Analysis, Vol. 31, 1994,
   L-Stable Parallel One-Block Methods for Ordinary Differential Equations.
3. J.C. Butcher et P. Chartier, Applied Numerical Mathematics, Vol. 17, 1995,
   Parallel general linear methods for stiff ordinary differential and differential algebraic equations.
4. R.P.K. Chan et P. Chartier, BIT, Vol. 36, 1996,
   A composition law for Runge-Kutta methods applied to index-2 differential-algebraic equations.
5. A. Aubry et P. Chartier, Applied Numerical Mathematics, Vol. 20, 1996,
   On the structure of errors for Radau IA methods applied to index-2 DAEs.
6. J.C. Butcher et P. Chartier, Journal of Applied Numerical Mathematics, Vol. 24, 1997,
   A generalization of singly-implicit Runge-Kutta methods.
7. J.C. Butcher, P. Chartier et Z. Jackiewicz, Numerical Algorithms, Vol. 16, 1997,
   Nordsieck representation of DIMSIMs.
8. A. Aubry et P. Chartier, SIAM Journal on Numerical Analysis, Vol. 35, 1998,
   On Improving the Convergence of Radau IIA Methods Applied to Index 2 DAEs.
9. A. Aubry et P. Chartier, BIT, Vol. 38, 1998,
   Pseudo-symplectic Runge-Kutta Methods.
10. A. Aubry et P. Chartier, BIT, Vol. 38, 1998,
    A note on pseudo-symplectic Runge-Kutta Methods.

11. P. Chartier, Journal of Computational and Applied Mathematics, Vol. 89, 1998,
On diagonally-iterated Runge-Kutta methods for dissipative ODEs.
12. P. Chartier, CWI Quaterly, Vol. 11, 1998,
The potential of parallel multi-value methods for the simulation of large real-life problems.
13. J.C. Butcher et P. Chartier, Numerical Algorithms, Vol. 20, 1999,
The effective order of singly-implicit Runge-Kutta methods.
14. J.C. Butcher, P. Chartier et Z. Jackiewicz, Numerical Algorithms Vol. 22, 1999,
Experiments with a variable-order type 1 DIMSIM code.
15. R.P.K. Chan et P. Chartier, New-Zealand Journal of Mathematics, Vol. 29, 2000,
Classification of High-Order Implicit Runge-Kutta Methods.
16. R.P.K. Chan , P. Chartier and A. Murua, Appl. Numer. Math.., Vol. 42, 2002,
Post-projected Runge-Kutta methods for index-2 differential-algebraic equations.
17. F. Bonnans, P. Chartier and H. Zidani, Control and Cybernetics, Vol. 32, No.1, 2003,
Discrete approximation of the Hamilton-Jacobi equation for a control system of a differential-algebraic system.
18. F. Castella, P. Chartier and E. Faou, C. R. Acad. Sci. Paris, Ser. I 336, 2003,
Analysis of a Poisson system with boundary conditions.
19. R.P.K. Chan , P. Chartier and A. Murua, Numerische Mathematik,Vol. 97, No. 3, 2004,
Reversible methods of Runge-Kutta type for Index-2 Differential-Algebraic Equations.
20. F. Castella, P. Chartier and E. Faou, Mathematical Modelling and Numerical Analysis, Vol. 38 No. 3, 2004, *Raman Laser Modeling : Mathematical and Numerical Analysis*.
21. E. Cancès, F. Castella, P. Chartier, E. Faou, C. Le Bris, F. Legoll and G. Turinici, Journal of Chemical Physics, Vol. 121 (21) 10346-10355, 2004,
High-order averaging schemes with error bounds for thermodynamical properties calculations by MD simulations.
22. F. Leplingard, C. Martinelli, S. Borne, L. Lorcy, T. Lopez, D. Bayart, F. Castella, P. Chartier, and E. Faou, IEEE Photonics Technology Letters, Vol. 16, No. 12, 2004,
Modeling of multi-wavelength Raman fiber lasers using a new and fast algorithm.
23. E. Cancès, F. Castella, P. Chartier, E. Faou, C. Le Bris, F. Legoll and G. Turinici, Numerische Mathematik, Vol. 100, 2005,
Long-time averaging using symplectic solvers with application to molecular dynamics.
24. P. Chartier, E. Faou and A. Murua, Numerische Mathematik, Vol. 103, 2006,
An algebraic approach to invariant preserving integrators : The case of quadratic and Hamiltonian invariants.
25. P. Chartier, E. Hairer, and G. Vilmart, Mathematics of Computation, Vol. 76, 2007,
Numerical integrators based on modified differential equations.
26. P. Chartier and A. Murua, IMA Journal of Numerical Analysis, Vol. 27, 2007,
Preserving first integrals and volume forms of additively split systems.
27. P. Chartier, E. Hairer and G. Vilmart, ESAIM Proceedings Vol 21, 2007,
Modified differential equations.
28. P. Chartier and E. Faou, M2AN, Vol. 42, No. 2, 2008,
Volume-energy preserving integrators for piecewise smooth approximations of Hamiltonian systems/
29. P. Chartier and E. Faou, J. Phys. A : Math. Theor. 41 No 47, 2008,
A simple proof of the existence of adiabatic invariants for perturbed reversible systems.
30. P. Chartier and A. Murua, M2AN, Vol. 43 No. 4, 2009,
An algebraic theory of order.
31. F. Castella, P. Chartier and E. Faou, SIAM J. Numer. Anal. Volume 47, Issue 4, 2009,
An averaging technique for highly-oscillatory Hamiltonian problems.

32. F. Castella, P. Chartier, S. Descombes and G. Vilmart, BIT Numerical Mathematics, Vol. 49, No. 3, 2009,
Splitting methods with complex times for parabolic equations.
33. P. Chartier, E. Hairer and G. Vilmart, FOCM, Vol. 10, No. 4, 2010
Algebraic structures of B-series.
34. P. Chartier, E. Darrigrand and E. Faou, en révision mineure pour publication dans BIT Numerical Methematics,
A Fast Multipole Method for Geometric Numerical Integrations of Hamiltonian Systems, Part I and Part II,
35. P. Chartier, J.M. Sanz-Serna and A. Murua, FOCM, to appear,
Higher-order averaging, formal series and numerical integration I : B-series.
36. M.P. Calvo, P. Chartier, J.M. Sanz-Serna and A. Murua,
Numerical experiments with the stroboscopic method, in preparation.
37. P. Chartier, J.M. Sanz-Serna and A. Murua,
Higher-order averaging, formal series and numerical integration II : the multi-frequency case, in preparation.
38. S. Blanes, F. Casas, P. Chartier and A. Murua,
Splitting methods with complex coefficients for some classes of evolution equations, in preparation.

Papers published as Proceedings of international conferences

1. P. Chartier,
Application of Bellen's Parallel Method to ODE's with Dissipative Right-Hand Side,
Proceedings of the 10^{th} International Conference on Computing Methods
in Applied Science and Engineering, Paris, France, February 11-14, 1992.
2. P. Chartier et B. Philippe,
L-Stable Parallel One-Block Methods for Stiff ODE's,
Proceedings of the sixth SIAM Conference on Parallel Processing for Scientific Computing, Norfolk, Virginia, USA, March 22-23, 1993.
3. J.C. Butcher et P. Chartier,
Parallel general linear methods for stiff ordinary differential and differential algebraic equations,
Proceedings of the 14^{th} IMACS World Congress on Computational and Applied Mathematics, Atlanta, Georgia, USA, July 11-15, 1994.
4. P. Chartier,
On diagonally-iterated Runge-Kutta methods for dissipative ODEs,
15^{th} IMACS World Congress, Berlin, Allemagne, 25-30 Août 1997.
5. A. Aubry et P. Chartier,
Pseudo-symplectic Runge-Kutta methods,
Proceedings of the Anode Conference, Auckland, New-Zealand, July 1998.
6. P. Chartier and E. Faou,
A numerical method for Hamiltonian systems based on piecewise smooth space-approximations,
Mathematisches Forschunginstitut Oberwolfach Report No. 14/2006.
7. M.P. Calvo, P. Chartier, J.M. Sanz-Serna and A. Murua, submitted,
A stroboscopic numerical method for highly oscillatory problems,
Proceedings of the Banff meeting "Numerical Analysis of Multiscale Computations", 2009.

Research Reports unpublished as articles

1. J.C. Butcher and P. Chartier,
   The construction of DIMSIMs for stiff ODEs and DAEs, Report Series No. 308, July 1994, University of Auckland, New Zealand.
2. P. Chartier and E. Lapôtre,
   Reversible B-series, INRIA report No. 1221, 1998.

Theses

1. P. Chartier, *Parallelism in the Numerical Solution of Initial Value Problems in Differential and Differential-Algebraic Equations*,
   Thesis No. 981, University of Rennes I, June 1993.
2. P. Chartier, *Numerical methods for ODEs and DAEs with application to hamiltonian systems*,
   Habilitation degree in mathematics, University of Rennes I, January 2000.

Softwares

▷ RADAU5M : numerical solver for DAEs.
Available at : http ://www.irisa.fr/ipso/perso/chartier.html
▷ RKPS63 : numerical solver for hamiltonian systems.
Available at : http ://www.irisa.fr/ipso/perso/chartier.html