

# CURRICULUM VITA

KEVIN R. PAYNE

## EDUCATION

1. Rice University: B.A.(Mathematics), Magna cum Laude; May 1984
2. State University of New York at Stony Brook; **Ph.D.** (Mathematics), August 1989, Dissertation Advisor: Michael E. Taylor

## ACADEMIC POSITIONS HELD (Institute, position, dates)

1. Università di Milano, **Associate Professor** (*Professore Associato*), 10/2001 - present. Tenured (*confermato*) as of Nov. 1, 2004
2. Università di Milano, Assistant Professor (*Ricercatore Unversitario*), 2/2000 - 9/2001.
3. Politecnico di Milano, Research Scientist (*Assegnista di Ricerca*), 12/98 - 1/2000.
4. Politecnico di Milano, Visiting Professor (supported by a CNR grant), 12/97 - 12/98
5. University of Miami, Assistant Professor, 8/91-5/98
6. Courant Institute of Mathematical Sciences, Visiting Member, 9/89-8/91
7. University of North Carolina at Chapel Hill, Visiting Graduate Assistant, 8/87-6/89
8. State University of New York at Stony Brook, Graduate Assistant, 8/84-8/89

## HONORS AND AWARDS

1. **Fellow of the American Mathematical Society**; nominated 11/2012 and inducted 01/2013;
2. American Mathematical Society Plenary Address, October 2010

**RESEARCH INTERESTS** (The numbers refer to the list of publications below) Partial differential equations of mixed and degenerate types, energy methods and maximum principles, linear and nonlinear functional analysis, microlocal analysis, geometric measure theory, applications to geometry and fluid mechanics.

- Pseudodifferential operator theory and nonlinear functional analysis (1,37)
- Microlocal analysis and solvability theory (2,3,4,5,6)
- Existence of weak solutions for linear problems (7,10,16,17,18,22,23,24,25,26,27,30)
- Maximum principles, spectral theory and Fredholm theory for linear problems (8,10,11,12,19,20,21,24,25,26,29,30)
- Variational and topological methods for nonlinear problems (7,8,9,12,13,14,20,21,22,23,24,25,29,31,32,33)
- Symmetry groups, conservations laws and geometric structures (14,15,22)
- Viscosity solutions for fully nonlinear equations (27,34,35,36)
- Geometric measure theory and weakly differentiable vector fields (28)

- Applications to fluid mechanics and plasma physics (16,22,25)
- Numerical methods for linear and nonlinear problems (29,30)

## **RESEARCH ACTIVITY**

### **US Grant funding**

1. **NSF Grant No. DMS-9206140**, Principal Investigator (PI) K.R. Payne, awarded June 1992, six months support for June-August 1993 and 1994, \$ 34.000;
2. University of Miami Summer Award in Natural Sciences and Engineering, awarded December 1991, three months support for June-August 1992, \$ 8.250.

### **Italian Grants and Prizes**

1. **GNAMPA Progetto di Ricerca 2017**; Istituto Nazionale di Alta Matematica; Principal Investigator K.R. Payne, awarded March 2017, 1800 EUR.
2. Research activity prize for 1999; Comitato d'Area del Dipartimento di Matematica, Università di Milano; awarded December 21, 2000, L. 2.000.000.
3. CNR Grant for Foreign Mathematicians, awarded January 26, 1998, six months of support for August-December, 1998.
4. CNR Grant for Foreign Mathematicians, awarded June 10, 1997, seven months support for December 1997 - July 1998.
5. CNR-GNAFA, Visiting Professor Program, awarded May 7, 1997, three months support for May-August 1997.
6. CNR-GNAFA, Visiting Professor Program, awarded May, 1995, six weeks support for June-July 1995.

### **Participation in Italian Research Groups**

1. MIUR National Project: “Equazioni alle derivate parziali e disuguaglianze funzionali: aspetti quantitativi, proprietà geometriche e qualitative, applicazioni.”; A. Cianchi (Director) e F. Gazzola (Local Coordinator); 01/07 - 12/08.
2. MIUR National Project: “Metodi Variazionali ed Equazioni Differenziali Nonlineari”; A. Ambrosetti (Director) e S. Terracini (Local Coordinator); 12/98 - 12/02; 01/04 - 12/04; 01/06 - 12/06.
3. MIUR National Project: “Metodi Variazionali e Topologici nello Studio di Fenomeni Non Lineari”; V. Benci (Director) e B. Ruf (Local Coordinator); 01/03 - 12/03 e 01/05 - 12/05.
4. University Research Group, Università di Milano: “Equazioni Differenziali Non Lineari ed Applicazioni”; B. Ruf (Director); 3/00 - present.

### **Editorial Responsibilities**

1. Member, Managing Board of the Milan Journal of Mathematics - appointed 2003;
2. Member, Editorial Board of Abstract and Applied Analysis - appointed 2012;
3. Peer Reviewer per National Research Council (USA);
4. Referee for more than 20 journals including: Duke Mathematical Journal, Journal of Functional Analysis, and Journal of Differential Equations.

### Direction of Post-Doctoral Scientists

1. Università di Milano Research Grant (Assegno di Ricerca) with Project Title: “Proprietà Qualitative per Soluzioni di Equazioni Differenziali Ellittiche Degeneri” awarded to Dr. Dario Monticelli for two years of support (Nov. 2006 - Oct. 2008) and renewed for the period Nov. 2008 - Oct. 2010.
2. Università di Milano Research Grant (Assegno di Ricerca) with Project Title: “PDE non lineari degeneri e con crescita critica: aspetti analitici, geometrici, fisici e numerici”, awarded to Dott. Marco Cirant for two years of support (Aug. 2014 - July 2016) and renewed for the period Aug. 2016 - Oct. 2016.
3. Università di Milano Research Grant (Assegno di Ricerca) with Project Title: “Fenomeni critici e degenerazione in PDE non lineari: aspetti analitici e geometrici”, awarded to Dott. Giulio Galise for seven months of support (Mar. 2018 - Feb 2020).

### Research Visits: More than 20 scientific visits made, including

1. Courant Institute of Mathematical Sciences - New York University, 15/11/08-15/12/08, 03/12/07-17/12/07, 15/11/06-15/12/06, 01/05/04-01/06/04, 15/11/02-15/12/02 e 15/11/00-15/12/00;
2. Fields Institute of Mathematical Sciences, Toronto, 17/09/08-21/09/08;
3. Rutgers University, New Brunswick, NJ, 27/11/06-30/11/06 e 01/11/02-10/11/02;
4. UNICAMP, Campinas, Brazil, 02/06/04-14/06/04

### Invited Talks: over 30 invited seminars delivered including:

1. Invited Address, “Celebration of Cathleen Synge Morawetz” - Courant Institute of Mathematical Sciences, New York, USA - November 2017;
2. Plenary Talk, Convegno “A Conference on Partial Differential Equations: Analytic and Geometric Aspects in honor of Michael Taylor’s 65th Birthday” - Chapel Hill, north Carolina, USA - Luglio, 2012;
3. Invited Address, “2009 Eastern Sectional Meeting of the American Mathematical Society” - University Park, Pennsylvania, USA - Ottobre 2009;
4. Plenary Talk, Convegno “Non-Linear Phenomena in Mathematical Physics: Dedicated to Cathleen Synge Morawetz on her 85th Birthday”, Fields Institute, Toronto, Canada, Settembre 2008;
5. New York University, Courant Institute of Mathematical Sciences, Dicembre 2007.

### Organization of Seminars and Conferences:

1. Special Session on Partial Differential Equations of Mixed Elliptic-Hyperbolic Type; AMA Eastern Sectional Meeting (University Park, PA) 24/10-25/10, 2009, con B. L. Keyfitz;
2. Special Session on Partial Differential Equations of Mixed Elliptic-Hyperbolic Type; AMS-UMI Joint Meeting Pisa 12/06-16/06, 2002, con D. Lupo e C. S. Morawetz;
3. Seminario Matematico e Fisico di Milano, **Member** of the Executive Committee (*Comitato Direttivo*) - elected December 2005 and **Secretary** - nominated January 2006;
4. Lezioni Leonardesche, Dipartimenti di Matematica della Università di Milano, Politecnico di Milano, Università di Milano-Bicocca; aprile 2002 - present, with: B. Ruf, C. Pagani, L. Di Martino, T. Weigel, F. Cipriani;

5. Seminario di Matematica Applicata, Dipartimento di Matematica “F. Enriques” - Università di Milano; 9/00 - 3/06, with: L. Pavarino, A. Ve eser, G. Aletti;
6. Courant Institute Quantization Seminar, Courant Institute of Mathematical Sciences - NYU, 8/90-12/90, with: J. Block, A. Weinstein.

### Professional Memberships

1. American Mathematical Society, January 1991 - present.
2. Unione Matematica Italiana, January 2001 - present.

### PUBLICATIONS

#### Refereed Journal Articles

- [1] Payne, K.R. - *Smooth tame Fréchet algebras and Lie groups of pseudodifferential operators*, **Comm. Pure Appl. Math.** **44**, no.3 (1991), 309–337.
- [2] Payne, K.R. - *Interior regularity of the Dirichlet problem for the Tricomi equation*, **J. Math. Anal. Appl.** **199**, no.1 (1996), 271–292.
- [3] Payne, K.R. - *Boundary geometry and location of singularities for solutions to the Dirichlet problem for Tricomi type equations*, **Houston J. Math.** **23**, no.4 (1997), 709–731.
- [4] Payne, K.R. - *Propagation of singularities for solutions to the Dirichlet problem for equations of Tricomi type*, **Rend. Sem. Mat. Univ. Politec. Torino** **54**, no.2 (1996), 39–61.
- [5] Payne, K.R. - *Solvability theorems for linear equations of Tricomi type*, **J. Math. Anal. Appl.** **215**, no.1 (1997), 262–273.
- [6] Payne, K.R. - *Propagation of singularities phenomena for equations of Tricomi type*, **Appl. Anal.** **68**, no.3-4 (1998), 195–206.
- [7] Lupo, D. and Payne, K.R. - *A dual variational approach to a class of nonlocal semilinear Tricomi problems*, **NoDEA Nonlinear Differential Equations Appl.** **6**, no.3 (1999), 247–266.
- [8] Lupo, D., Micheletti, A.M., and Payne, K.R. - *Existence of eigenvalues for reflected Tricomi operators and applications to multiplicity of solutions for sublinear and asymptotically linear nonlocal Tricomi problems*, **Adv. Differential Equations** **4**, no.3 (1999), 391–412.
- [9] Lupo, D. and Payne, K.R. - *Multiplicity of nontrivial solutions for an asymptotically linear nonlocal Tricomi problem*, **Nonlinear Anal. Ser. A: Theory, Methods** **46**, no.1 (2001) 591–600.
- [10] Lupo, D. and Payne, K.R. - *On the maximum principle for generalized solutions to the Tricomi problem*, **Commun. Contemp. Math.** **2**, no.4 (2000), 535–557.
- [11] Lupo, D. and Payne, K.R. - *Existence of a principal eigenvalue for the Tricomi problem*, in “Proceedings of the Conference on Nonlinear Differential Equations (Coral Gables, FL, 1999)”, 173–180 (electronic), **Electron. J. Differ. Equ. Conf.** **05** Southwest Texas State Univ., San Marcos, TX, 2000.
- [12] Lupo, D. and Payne, K.R. - *Spectral bounds for Tricomi problems and applications to semilinear existence and existence with uniqueness*, **J. Differential Equations** **184**, no.1 (2002), 139–162.

- [13] Lupo, D. and Payne, K.R. - *Critical exponents for equations mixed elliptic-hyperbolic and degenerate types*, **Comm. Pure Appl. Math.** **56**, no.3 (2003), 403–424.
- [14] Lupo, D. and Payne, K.R. - *Conservation laws for equations of mixed elliptic-hyperbolic and degenerate types*, **Duke Math. J.** **127**, no.3 (2005), 251–290.
- [15] Payne, K.R. - *Singular metrics and associated conformal groups for operators of mixed and degenerate types*, **Ann. Mat. Pura Appl.** **185**, no. 4 (2006), 613–625.
- [16] Lupo, D., Morawetz, C.S. and Payne, K.R. - *On closed boundary value problems for equations of mixed elliptic-hyperbolic type*, **Comm. Pure Appl. Math.** **60**, no. 9 (2007), 1319–1348.
- [17] Payne, K.R. - *Weak well-posedness for the Dirichlet problem for equations of mixed elliptic-hyperbolic type*, **Le Matematiche** **60** (2005), 315–327.
- [18] Payne, K.R. - *Multiplier methods for mixed type equations*, **Int. J. Appl. Math. Stat.** **8** (2007), 58–75.
- [19] Monticelli, D.D. and Payne, K.R. - *Maximum principles for elliptic equations with a uniformly elliptic direction*, **J. Differential Equations** **247**, no. 7 (2009), 1993–2026.
- [20] Lupo, D., Monticelli, D.D. and Payne, K.R. - *Spectral Theory for Linear Operators of Mixed Type and Applications to Nonlinear Dirichlet Problems*, **Comm. Partial Differential Equations** **37** (2012), 1495–1516.
- [21] Lupo, D., Monticelli, D.D. and Payne, K.R. - *Fredholm properties and nonlinear Dirichlet problems for mixed type operators*, **J. Math. Anal. Appl.** **397** (2013), 837–860.
- [22] Keyfitz, B.L., Tesdall, A.M., Payne, K.R. and Popivanov, N.I. - *The sonic line as a free boundary*, **Quart. Appl. Math.** **71** (2013), 119–133.
- [23] Lupo, D., Payne, K.R. and Popivanov, N.I. - *On the degenerate hyperbolic Goursat problem for linear and nonlinear equations of Tricomi type*, **Nonlinear Anal.** **108** (2014), 29–56.
- [24] Lupo, D., Monticelli, D.D. and Payne, K.R. - *Variational characterizations of weak solutions to the Dirichlet problem for mixed type equations*, **Comm. Pure Appl. Math.** **68** (2015), 1569–1586.
- [25] Lupo, D., Monticelli, D.D. and Payne, K.R. - *On the Dirichlet problem of mixed type for lower hybrid waves in axisymmetric cold plasmas*, **Arch. Rational Mech. Anal.** **217** (2015), 37–69.
- [26] Monticelli, D.D., Payne, K.R. and Punzo, F. - *Poincaré inequalities for Sobolev spaces with matrix weights and applications to degenerate partial differential equations*, **Proc. Roy. Soc. Edinburgh Sect. A**, Published Online: 22 April 2018, DOI: 10.1017/S0308210517000427, in press.
- [27] Cirant, M. and Payne, K.R. - *On viscosity solutions to the Dirichlet problem for elliptic branches of nonhomogeneous fully nonlinear equations*, **Publ. Mat.** **61** (2017), 529–575.
- [28] Comi, G.E. and Payne, K.R. - *On locally essentially bounded divergence measure fields and sets of locally finite perimeter*, **Adv. Calc. Var.**, Published Online: 12 December 2017, DOI: <https://doi.org/10.1515/acv-2017-0001>, in press.

#### Refereed Articles in Monographs

- [29] Payne, F.R. and Payne, K.R. - *New facets of DFI, a DE solver for all seasons*, in “Integral Methods in Science and Engineering, Vol. 2 (Oulu 1996)”, 176–180, **Pitman Res. Notes Math. Ser.**, **375**, Longman, Harlow, 1997.

- [30] Payne, F.R. and Payne, K.R. - *Linear and sublinear Tricomi via DFI*, in “Integral Methods in Science and Engineering (Houghton, MI, 1998)”, 268–273, **Chapman & Hall/CRC Res. Notes Math.** **418**, Chapman & Hall/CRC, Boca Raton, FL, 2000.
- [31] Lupo, D. and Payne, K.R. - *The dual variational method in nonlocal semilinear Tricomi problems*, in “Nonlinear analysis and its applications to differential equations (Lisbon, 1998)”, 321–338, **Progr. Nonlinear Differential Equations Appl.** **43**, Birkhäuser Boston, Boston, MA, 2001.
- [32] Lupo, D., Payne, K.R. and Popivanov, N.I. - *Nonexistence of nontrivial solutions for supercritical equations of mixed elliptic-hyperbolic type*, 371–390, **Progr. Nonlinear Differential Equations Appl.** **66**, Birkhäuser Verlag, Basel, 2006.
- [33] Dechevski, L., Payne, K.R. and Popivanov, N.I. - *Nonexistence of nontrivial generalized solutions for 2-D and 3-D BVPs with nonlinear mixed type equations*, in “Proceedings of the 43rd International Conference Applications of Mathematics in Engineering and Economics”, 1–13, **AIP Conference Proceedings** **1910**, **040015**, Melville, NY , 2017.

### Preprints

- [34] Cirant, M. and Payne, K.R. - *Comparison principles for viscosity solutions of elliptic branches of fully nonlinear equations independent of the gradient*, preprint (2018).
- [35] Birindelli, I. and Payne, K.R. - *Principal eigenvalues for  $k$ -Hessian operators by maximum principle methods*, preprint (2018).
- [36] Cirant, M. Harvey, F.R., Lawson Jr., H.B. and Payne, K.R. - *Comparison principles by monotonicity and duality for constant coefficient nonlinear potential theory and PDEs*, preprint (2018).

### Theses

- [37] Payne, K. R. - *Smooth tame Fréchet algebras and Lie groups of pseudodifferential operators*, Ph.D. Dissertation, SUNY-Stony Brook, 1989.

### TEACHING ACTIVITY

#### Prizes received

- Chairman’s Award, Department of Mathematics, SUNY-Stony Brook, Maggio 1986.

**Theses supervised:** Detailed list available at the website

<http://www.mat.unimi.it/users/payne/ThesisSupervisionApril19.pdf>

- Ph.D. Thesis: Università di Milano - D. Monticelli, 2007;
- Masters Theses (Tesi di Laurea, Vecchio Ordinamento and Laurea Magistrale): Università di Milano - **21 theses** during the period 2002-2018;
- Undergraduate Theses (Laurea Triennale): Università di Milano - **32 theses** during the period 2002-2014.
- Bachelor’s Thesis: University of Miami - R. Millares, 1997.

**Courses taught:** Instructor of over **80 courses in Mathematics** involving **34 distinct syllabi** (*programma d'esame*) in various universities in Italy and the United States of America. detailed list available at the website

<http://www.mat.unimi.it/users/payne/CoursesTaughtApril19.pdf>

- Università degli Studi di Milano
  - **2 courses** for the Ph.D Program in Mathematics (2004, 2019);
  - **22 courses** for the Master's Degree Program (Laurea Magistrale) in Mathematics (2002-2019);
  - **12 courses** for the Undergraduate Degree Program (Laurea Triennale) in Mathematics (2001-2019);
  - **2 courses** for the Undergraduate Degree Program (Laurea Triennale) in Physics (2017-2019);
  - **2 courses** for the Undergraduate Degree Program (Laurea Triennale) in Computer Science (2001-2003);
  - **2 courses** for the Undergraduate Degree Program (Laurea Triennale) in Digital Communication (2009-2011).
- Politecnico di Milano - Campus Bovisa: **2 courses** for the Undergraduate Degree Program (Laurea Vecchio Ordinamento) in Aerospace Engineering (1998-2000);
- Università Degli Studi Dell'Insubria - Sede Varese: **1 course** for the Undergraduate Degree Program (Diploma) in Computer Science (1998-1999);
- University of Miami: **26 courses** during the period 1991-1997;
- University of North Carolina: **4 courses** during the period 1987-1989;
- SUNY-Stony Brook: **5 courses** during the period 1984-1987;
- University of Texas at Arlington: **1 course** during the period 1984-1985.

### Course notes produced

1. K. R. Payne - *Equazioni alle Derivate Parziali*, (2014), 147 pagine, scaricabile in rete all'indirizzo [http://www.mat.unimi.it/users/payne/PDE\\_AA14-15.pdf](http://www.mat.unimi.it/users/payne/PDE_AA14-15.pdf);
2. K. R. Payne - *Analisi Reale, Parte I*, (2007), 84 pagine, scaricabile in rete all'indirizzo <http://www.mat.unimi.it/users/payne/AnRealeLezParte1.pdf>;
3. K. R. Payne - *Raccolta di Esercizi di Analisi Reale, Parte I*, (2007), 12 pagine, scaricabile in rete all'indirizzo <http://www.mat.unimi.it/users/payne/EserAnRealeParte1-07-08.pdf>;
4. K. R. Payne - *Misura ed Integrazione*, (2012), 108 pagine, scaricabile in rete all'indirizzo [http://www.mat.unimi.it/users/payne/An4\\_notes\\_11-12.pdf](http://www.mat.unimi.it/users/payne/An4_notes_11-12.pdf);
5. K. R. Payne - *Funzioni Armoniche: Un Primo Assaggio*, (2006) , 19 pagine, scaricabile in rete all'indirizzo <http://www.mat.unimi.it/users/payne/anIIIfunzarm05-06.pdf>;
6. K. R. Payne - *Lezioni di Analisi III*, (2006) , 84 pagine, scaricabile in rete all'indirizzo <http://www.mat.unimi.it/users/payne/anIIILez05-06.pdf>;

7. K. R. Payne - *Richiami di Analisi II*, (2005) , 14 pagine, scaricabile in rete all'indirizzo <http://www.mat.unimi.it/users/payne/anIIrichiami04-05.pdf>.

## **UNIVERSITY SERVICE**

### **University Committee and Administrative Responsibilities**

1. **Coordinator** of the Faculty Committee for the Teaching and Certification of English - Facoltà di Scienze MM.FF.NN., Università di Milano: from March 2003 until November 2007;
2. Elected member of the Administrative Committee (Giunta del Dipartimento) of the Dipartimento di Matematica dell'Università di Milano: from September 2005 until August 2008;
3. Elected member of the Teaching Committee (Commissione Didattica) of the Dipartimento di Matematica dell'Università di Milano: from February 2006 until March 2009;
4. Member of the Curriculum Committee (Commisione Piani di Studio) for the Laurea Magistrale in Matematica - Consiglio Didattico del Dipartimento di Matematica dell'Università di Milano: from September 2003 until September 2009 and September 2017 - present;
5. Member of the Curriculum Committee (Commisione Piani di Studio) for the Laurea Magistrale in Matematica per le Applicazioni - Consiglio Didattico del Dipartimento di Matematica dell'Università di Milano - dal settembre 2004 al settembre 2009;
6. Member of the Certification of English Committee (Commissione Prova di Lingua Inglese) for the Laurea and Laure Triennale in Matematica - Consiglio Didattico del Dipartimento di Matematica dell'Università di Milano: from January 2001.
7. Elected member of the Undergraduate Curriculum Committee- University of Miami: during the academic years 92/93 - 96/97.

Milano, April 30, 2019

Kevin R. Payne