Curriculum Vitae of **Sorin Dragomir**[1]

Studies

1992 Ph.D. in Mathematics, State University[2] of New York at Stony Brook.

Positions

2001- Professor[3] (*Professore Ordinario di Analisi Matematica*) at *Dipartimento di Matematica, Informatica ed Economia* dell'*Università degli Studi della Basilicata*, Potenza, Italy.

1993-2001 Associate Professor (*Professore Associato di Geometria*) at *Politecnico di Milano*, Milan, Italy (1993-1996) and *Università degli Studi della Basilicata*, Potenza, Italy (1996-2001).

Research interests

My present research interests ramify into several on-going projects, partially aimed to applications of complex analysis, partial differential equations and differential geometry to certain aspects of General Relativity Theory, as described below. The leading theme consists of the study of tangential Cauchy-Riemann equations $\overline{\partial}_b u = 0$ both with analytic and geometric methods. The methods more strictly belonging to

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mathematical analysis (approximation of CR functions by sequences of holomorphic functions, Fourier transforms, analytic discs and the Bishop equation) are meant to be applied both to scalar and vector valued (i.e. $\mathfrak{X}$-valued, where $\mathfrak{X}$ is an infinite dimensional complex Fréchet space) CR functions, also aiming to applications to multi-dimensional analytic functional calculus (related to Taylor's joint spectrum of a commutative system of operators).

The geometric methods are adopted in the presence of a CR structure $T_{1,0}(M) \subset T(M) \otimes \mathbb{C}$ on a given real odd dimensional manifold M, which is a bundle theoretic recast of tangential Cauchy-Riemann equations. Under certain nondegeneracy assumptions one endows M with several additional geometric objects, such as contact forms θ, the Tanaka-Webster connection ∇ of (M, θ), the sublaplacian Δ_b, and Fefferman's metric F_θ. The sublaplacian is a subelliptic operator with a loss of half derivative whose presence on a given pseudohermitian manifold (M, θ) prompts the application of subelliptic theory [which is believed to play within CR geometry the more consolidated role played by elliptic theory in Riemannian geometry]. Fefferman's metric is a Lorentzian metric [on the total space of the canonical circle bundle over a given CR manifold] and its occurrence [historically related to the investigation of the boundary behavior of the Bergman kernel of a smoothly bounded strictly pseudoconvex domain $\Omega \subset \mathbb{C}^n$] leads to a useful relationship between hyperbolic and subelliptic theories. The sublaplacian Δ_b appears in a natural manner in a number of problems of geometric analysis [such as the Dirichlet problem, say for the subellitic harmonic maps system] which may be successfully handled by using subelliptic theory tools. A central such tool is the Poincaré inequality for a Hörmander system of tangent vector fields. The overall hope is that results of differential geometric nature may ultimately shed light on the (local and global) properties of solutions to the tangential Cauchy-Riemann equations.

There are other instances of the interrelation between Lorentzian geometry and space-time physics, such as discovered by I. Robinson, A. Trautmann and, L. Koch in relation to shear free null geodesic congruences. For instance one may pinpoint a null Killing vector field K on Gödel's universe $\mathcal{G}^4_\alpha$ such that the orbit space $M^3 = \mathcal{G}^4_\alpha / K$ carries a natural strictly pseudoconvex CR structure. In this context $\mathcal{G}^4_\alpha$ may be organized as a principal bundle $\mathbb{R} \to \mathcal{G}^4_\alpha \to M^3$ and invariant wave maps from Gödel's universe project to subelliptic harmonic maps from M^3 (which may then be studied by subelliptic theory methods). On the other hand Gödel's metric g_α is the solution to a set of gravitational field equations admitting other solutions (e.g. Einstein's static universe) which may be used as a geometric background for reaching entirely different physics conclusions, resulting into the failure to include Mach's principle into General Relativity. According to Mach's principle the matter distribution of the universe should uniquely determine the geometry of the universe. Gödel's solution g_α shows that Mach's principle is not build into General Relativity through the gravitational field equations alone. It is our line of thought that one may distinguish between physically different solutions of Einstein equations by looking at their boundaries, such as meant within the theory of singularities of space-times. Schmidt and conformal boundaries are well known boundary constructions, associated to a given space-time $\mathfrak{M}$. Both are highly difficult to compute and progress in this direction may be achieved by dimension reduction arguments, aiming to determine certain subsets of points of a given boundary $\partial\mathfrak{M}$. For instance one may attempt the calculation of $\left(\partial\mathcal{G}^4_\alpha\right)/\mathbb{R}$ which is a pseudohermitian analog to Schmidt's boundary on M^3.

My general goal within my research activities is to participate at the preservation, dissemination and development of Western mathematical sciences.

Teaching statement

Teaching is inseparable from research work. Being an active researcher improves the quality of the lessons *ex cathedra* (whose level will be not too distant from the present scientific knowledge) and accurate and precise teaching, together with a lucid amount of philosophy placing correctly mathematics within the body of human culture, is highly rewarding: whatever a scholar gives in terms of dissemination of mathematics culture he will receive back as a "transfer" of enthusiasm and motivation from his young public. Specific to the process of mathematics education is the need of commitment to teach classes at the basic introductory level besides from teaching more advanced arguments: this will attract young talents and facilitate later choices in a field (that of mathematics) where the return (in terms of job opportunities and personal intellectual reward) is more difficult to evaluate (than in fields of scientific activity possessing direct means of disclosure). As frankly most academic research results are not bound to find concrete applications in a life span, teaching remains a basic modality a researcher does have in order to do his share of duty within human society.

Publication List (recent publications)

I. Papers

1. *Exponentially subelliptic harmonic maps from the Heisenberg group into a sphere*, CALCULUS OF VARIATIONS AND PARTIAL DIFFERENTIAL EQUATIONS, 58(2018), 125 `https://doi.org/10.1007/s00526-019-1575-3` (with Yuan-Jen Chiang and Francesco Esposito)

2. *Solitonic metrics and harmonic maps*, ANALYSIS AND MATHEMATICAL PHYSICS, (2018), 1-35 `https://doi.org/10.1007/s13324-018-0269-x` (with Guilin Yang)

3. *Bergman-harmonic maps of balls*, ANNALI DELLA SCUOLA NORMALE SUPERIORE DI PISA. CLASSE DI SCIENZE, vol. XV, 2016, p. 269-307, ISSN: 0391-173X (with E. Barletta)

4. *Linearized pseudo-Einstein equations on the Heisenberg group*, JOURNAL OF GEOMETRY AND PHYSICS, vol. 112, 2016, p. 95-105, ISSN: 0393-0440 (with Elisabetta Barletta and Howard Jacobowitz)

5. *A lower bound on the spectrum of the sublaplacian*, THE JOURNAL OF GEOMETRIC ANALYSIS, vol. 25, 2015, p. 1492-1519, ISSN: 1050-6926 (with A. Aribi and A. El Soufi)

6. *Eigenvalues of the sub-Laplacian and deformations of contact structures on a compact CR manifold*, DIFFERENTIAL GEOMETRY AND ITS APPLICATIONS, vol. 39, 2015, p. 113-128, ISSN: 0926-2245 (with A. Aribi and A. El Soufi)

7. *Eigenvalues of the sublaplacian and deformations of contact structures on a compact CR manifold*, DIFFERENTIAL GEOMETRY AND ITS APPLICATIONS, vol. 39, 2015, p. 113-128, ISSN: 0926-2245 (with A. Aribi and A. El Soufi)

8. *Proper holomorphic maps in harmonic map theory*, ANNALI DI MATEMATICA PURA ED APPLICATA, vol. 194, 2015, p. 1469-1498, ISSN: 1618-1891 (with E. Barletta)

9. *Self-dual solutions to pseudo Yang-Mills equations*, NONLINEAR ANALYSIS, vol. 126, 2015, p. 45-68, ISSN: 1873-5215 (with E. Barletta and M. Magliaro)

10. *Propagation of singularities along characteristics of Maxwell's equations*, PHYSICA SCRIPTA, vol. 89, 2014, p. 1-13, ISSN: 0031-8949 (with E. Barletta)

11. *Schmidt boundaries of foliated space-times*, CLASSICAL AND QUANTUM GRAVITY, vol. 31, 2014, p. 1-28, ISSN: 0264-9381 (with E. Barletta and M. Magliaro)

12. *Wave maps from Gödel's universe*, CLASSICAL AND QUANTUM GRAVITY, vol. 31, 2014, p. 1-52, ISSN: 0264-9381 (with E. Barletta and M. Magliaro)

13. *CR immersions and Lorentzian geometry Part II: A Takahashi type theorem*, RICERCHE DI MATEMATICA, 2013, p. 1-24, ISSN: 1827-3491 (with A. Minor)

14. *CR immersions and Lorentzian geometry Part I: pseudohermitian rigidity of CR immersions*, RICERCHE DI MATEMATICA, vol. 62, 2013, p. 229-263, ISSN: 1827-3491 (with A. Minor)

15. *Harmonic maps of foliated Riemannian manifolds*, GEOMETRIAE DEDICATA, vol. 162, 2013, p. 191-229, ISSN: 0046-5755 (with A. Tommasoli)

16. *Mixed gravitational field equations on globally hyperbolic spacetimes*, CLASSICAL AND QUANTUM GRAVITY, vol. 30, 2013, p. 1-26, ISSN: 0264-9381 (with E. Barletta, V. Rovenski and M. Soret)

17. *On the regularity of weak contact p-harmonic maps*, JOURNAL OF COMPLEX ANALYSIS, vol. 1, 2013, p. 1-17, ISSN: 2314-4963 (with R. Petit)

18. *Baouendi-Trèves approximation theorem for CR functions with values in a complex Fréchet space*, ANNALI DELL'UNIVERSIT DI FERRARA. SCIENZE MATEMATICHE, 2012, p. 1-24, ISSN: 1827-1510 (with S. Nishikawa)

19. *Contact harmonic maps*, DIFFERENTIAL GEOMETRY AND ITS APPLICATIONS, vol. 30, 2012, p. 65-84, ISSN: 0926-2245 (with R. Petit)

20. *Levi harmonic maps of contact Riemannian manifolds*, JOURNAL OF GEOMETRIC ANALYSIS, 2012, p. 1-40, ISSN: 1559-002X (with D. Perrone)

21. *On Lewy's unsolvability phenomenon*, COMPLEX VARIABLES AND ELLIPTIC EQUATIONS, vol. 57, 2012, p. 971-981, ISSN: 1747-6933 (with E. Barletta)

22. *On the continuity of the eigenvalues of a sublaplacian*, CANADIAN MATHEMATICAL BULLETIN, 2012, p. 1-13, ISSN: 0008-4395 (with A. Aribi and A. El Soufi)

23. *Subelliptic biharmonic maps*, THE JOURNAL OF GEOMETRIC ANALYSIS, 2012, p. 1-23, ISSN: 1050-6926 (with S. Montaldo)

24. *b-Completion of pseudo-Hermitian manifolds*, CLASSICAL AND QUANTUM GRAVITY, vol. 29, 2012, p. 1-27, ISSN: 0264-9381 (with E. Barletta, H. Jacobowitz and M. Soret)

II. Books

1. *Harmonic vector fields: variational principles and differential geometry*, Elsevier, Amsterdam-Boston-Heidelberg-London-New York-Oxford-Paris-San Diego-San Francisco-Singapore-Sydney-Tokyo, 2011, ISBN 978-0-12-415826-9 (with D. Perrone).

2. *Foliations in Cauchy-Riemann geometry*, Mathematical Surveys and Monographs, Vol. 140, American Mathematical Society, 2007 (with E. Barletta and K.L. Duggal).

3. *Differential geometry and analysis on CR manifolds*, Progress in Mathematics, Vol. 246, Birkhäuser, Boston-Basel-Berlin, 2006 (with G. Tomassini).

4. *Locally conformal Kähler geometry*, Progress in Mathematics, Vol. 155, Birkhäuser, Boston-Basel-Berlin, 1998 (with L. Ornea).

Teaching experience

I have taught several courses in differential geometry, complex analysis (in one and several complex variables), functional analysis, and partial differential equations, both at the undergraduate and graduate level. In the last five years my teaching load included graduate classes within the doctoral programs in Bologna and Lecce. I have authored several textbooks (written for didactic purposes) in basic calculus and geometry.