Anno: 2018 - prot. BIRD181249

Richiesta di finanziamento per Progetto/Assegno di Ricerca

Progetto

1.0 Macroarea di Afferenza del Responsabile Scientifico del Programma di Ricerca
Principal Investigator's macroarea

1 - Matematica, scienze fisiche, dell'informazione e della comunicazione, ingegneria e scienze della Terra

1.1 Area Scientifica del Responsabile Scientifico del Programma di Ricerca
Principal Investigator's scientific area

01 - Scienze Matematiche

1.2 Responsabile Scientifico del Programma di Ricerca
Principal Investigator (PI)

DE MARCHI	Stefano	M
(Cognome/Surname)	(Nome/Name)	(sesso/gender)
PROFESSORE ASSOCIATO	MAT/08	17/12/1962
(Qualifica/Category)	(Settore Scientifico Disciplinare/ Scientific Disciplinary Sector)	(Data di Nascita/Date of Birth)
DMRSFN62T17B589H		DIP. MATEMATICA "TULLIO LEVI CIVITA" - DM
(Codice fiscale/Tax code)		(Dipartimento/Department)
+39 0498271313	+39 0498271499	demarchi@math.unipd.it
(Prefisso e Telefono/ Code and Phone Number)	(Numero Fax)	(Indirizzo di Posta Elettronica/E-mail Address)

Lingua di compilazione del progetto
Language

English

1.3 Area Scientifica del Programma di Ricerca
Scientific area of the research program

Area Scientifica Prevalente /Main scientific Area	**Scienze Matematiche**	(% di afferenza) 60
Area Scientifica/Scientific Area	**Scienze Fisiche**	(% di afferenza) 20
Area Scientifica/Scientific Area	**Scienze Mediche**	(% di afferenza) 20

1.4 Titolo del Programma di Ricerca
Title

NATIRESCO: Nonstandard multivariate Approximation Techniques in medical Imaging, REmote geospatial Sensing and Computational Optics

1.5 Abstract del Programma di Ricerca
Abstract

The project NATIRESCO, which is intrinsically interdisciplinary, aims to develop new mathematical methodologies, by means of nonstandard mathematical techniques, in medical imaging analysis, for images acquired either by MRI (Magnetic Resonance)/MPI (Magnetic Particle) or PET (Positron Emission Tomography), and in two life sciences fields known as remote geospatial sensing and optics. We have subdivided the project in two guidelines, L1 and L2, corresponding to the main areas of interest of our applications: medicine and geophysics in broad sense.

L1: Approximation of medical images.
We mainly consider neuroimages (images of brain regions) that we would like to approximate by means of kernel-based methods and, for image comparisons, we use the Monge-Kantorovich Optimal Transport approach based on Wasserstein metric. Moreover we investigate the classification of time activity curves in PET imaging. In particular, we try different mathematical approaches to classify them and hence automatically discriminate between brain regions with different metabolic behavior.

L2: Applications of Sparse Approximation by Caratheodory-Tchakaloff Quadrature Compression.
By using a discrete version of Caratheodory-Tchakaloff theorem, we wish to perform image compression in the framework of remote geospatial sensing. In the framework of computational adaptive optics, the computation of the RMSWE (Root Mean Square Wavefront Error) is done by ray tracing in optical systems where the entrance pupil has a complex shape. This is relevant for example in controlling obscuration and vignetting of the LSST (Large Synoptic Survey Telescope) camera by intersection/difference with several coassial disks. We can construct algebraic Gaussian quadrature formulas on such pupils by domain splitting.

1.6 Settori scientifico-disciplinari interessati dal Programma di Ricerca
Scientific Disciplinary Sectors

MAT/08 MED/36

1.7 Parole chiave
Keywords

1. AREA 01 - Mathematics - Approximations And Expansions - MULTIDIMENSIONAL PROBLEMS
2. AREA 01 - Mathematics - Numerical Analysis - Numerical Approximation And Computational Geometry (Primarily Algorithms) - INTERPOLATION
3. AREA 07 - Medicine - Med/36 - Diagnostic Imaging And Radiotherapy - IMAGING DIAGNOSIS AND RADIOTHERAPY
4. Optimal transport problem in imaging

1.8 Curriculum del Responsabile Scientifico del programma di ricerca
Principal Investigator's curriculum

** Scholar addresses
1987: degree in Mathematics (University of Padova)
1994: Ph.D. in Computational Mathematics and Computer Science, VI-cycle Consortium NE, Padova

** Positions
1995-2005: assistant professor of Numerical Analysis
2005-present: associate professor of Numerical Analysis
2017: habilitation to full professor of Numerical Analysis

** Research interests
Multivariate polynomial approximation, Radial Basis Functions approximation, Applications to medical imaging reconstruction and analysis, quasi Monte-Carlo compression

** Scientific publications
69 papers on refererred journals
18 papers on referred proceedings
6 edited proceeding
4 monographs
software

** Conference organization, editorial experience, review service
- Member of the organizing and scientific committees of Dolomites Workshop on Constructive Approximation and Applications (DWCAA06-09-12-16), Alba di Canazei (Trento, Italy), September 2006, 2009, 2012, 2016.
- Member of the organizing committees of the Dolomites Research Week on Approximation 2007, 2008, 2010, 2011, 2013, 2014, 2015, 2017 and 2018 at Alba di Canazei.
- Managing editor of "Dolomites Research Notes on Approximation" (http://drna.padovauniversitypress.it/) since 2008.
- Member of the Editorial Board of the Aracne pub.
BIOMATHEMATICS AND NUMERICAL ANALYSIS BOOK SERIES
- Referee for (list not completed): AMS-Math. Rev., Siam J. Matrix Anal. Appl., Siam J. Numer. Anal., J. Approx. Theory, Adv. Comput. Math., Numer. Math., J. Complexity, Compu. Math. Appl., Simul. Model. Practise and Th., J. Comput. Appl. Math., Numer. Algorithms, Proceedings A Royal Mathematical Society, Mediterranean J. Math., International Math. J., Appl. Math. E-Notes, Methods and Applications of Analysis.

** Fellowships/Visiting
- Post-doc at the University of Padova: February - December 1995.
- CNR program "Short-term mobility": Oct. 1998 and June 1999.
- DAAD (Deutscher Akademisher Austauschdienst): exchange program between researchers of European countries, 2001.
- Erskine Visiting programme: University of Canterbury, Jul.-Aug. 2018.

** Supervisor experience
1 PhD thesis in Computational Mathematics
1 PhD thesis in Medical Sciences
6 degree theses in Mathematics
20 master theses in Mathematics
1 master thesis in Applied Mathematics
1 degree thesis in Computer Science
co-supervisor of 3 master theses in Mathematics (Univer. of Verona, Padova and Calabria).

** Research Coordination
- Founder of the CAA: Padova-Verona Research Group on Constructive Approximation and Applications
- Coordinator of RITA: ITalian Network on Approximation

** Recent funded projects
- Scientific coordinator of the research grant "Radial basis functions approximations: stability issues and applications", University of Padova (23.6K euros, 2017).
- Scientific Coordinator of the National GNCS-INdAM 2017 project: "Approssimazione Multivariata: teoria e applicazioni" (7.8K eurors).
- Scientific coordinator of DOR funds of the Departement of Mathematics 2017: 5.7K euros.
- Scientific coordinator of the research grant "Approximation by radial basis functions: partition of unity methods, applications to the solution of PDEs and medical imaging", University of Padova (23.6K euros, 2018).

** Bibliometrics
- Co-authors (from Scopus) = 50
- MathSciNet: 68 publications, 343 citations
- Google Schoolar: 1209 citations, h-index=18
- Scopus: 63 publications, 560 citations, h-index=14
- ISI: 58 publications, 442 citations, h-index=13
- ResearchGate: 103 publications, 770 citations, RG score=28.82, h-index=15
- MR Erdos Number=2

More details: http://www.math.unipd.it/~demarchi/mioCVEnglish.pdf

1.9 Pubblicazioni scientifiche più significative del Responsabile Scientifico del Programma di Ricerca
Principal Investigator's publications

nº	Pubblicazione
1.	De Marchi Stefano (2018). Quasi-Monte Carlo integration on manifolds with mapped low-discrepancy points and greedy minimal Riesz s-energy points. APPLIED NUMERICAL MATHEMATICS, vol. 127, p. 110-124, ISSN: 0168-9274, doi: 10.1016/j.apnum.2017.12.017 -Impact Factor 1.087
2.	Bos L., De Marchi S., Vianello M. (2017). Polynomial approximation on Lissajous curves in the d-cube. APPLIED NUMERICAL MATHEMATICS, vol. 117, p. 47-56, ISSN: 0168-9274, doi: http://doi.org/10.1016/j.apnum.2017.01.013 -Impact Factor 1.087
3.	de Marchi, S., KroÃ³, A. (2017). Marcinkiewiczâ-Zygmund type results in multivariate domains. ACTA MATHEMATICA HUNGARICA, p. 1-21, ISSN: 0236-5294, doi: 10.1007/s10474-017-0769-4
4.	Stefano, De Marchi, MARCHETTI, FRANCESCO, Wolfgang, Erb (2017). Spectral filtering for the reduction of the Gibbs phenomenon of polynomial approximation methods on Lissajous curves with applications in MPI. DOLOMITES RESEARCH NOTES ON APPROXIMATION, vol. 10, p. 128-137, ISSN: 2035-6803, doi: 10.14658/pupj-drna-2017-Special_Issue-13
5.	De Marchi Stefano, Idda Andrea, Santin Gabriele (2017). Approximation Theory XV: San Antonio 2016. In: (a cura di): Gregory E. Fasshauer and Larry L. Schumaker, Approximation Theory XV: San Antonio 2016. vol. 201, p. 39-59, Springer International Publishing, ISBN: 978-3-319-59911-3, doi: 10.1007/978-3-319-59912-0
6.	Cavoretto R., De Marchi S., De Rossi A., Perracchione E., Santin G. (2016). Partition of unity interpolation using stable kernel-based techniques. APPLIED NUMERICAL MATHEMATICS, ISSN: 0168-9274, doi: doi:10.1016/j.apnum.2016.07.005 -Impact Factor 1.087
7.	BOS, LEONARD PETER, DE MARCHI, STEFANO, VIANELLO, MARCO (2016). Trivariate polynomial approximation on Lissajous curves. IMA JOURNAL OF NUMERICAL ANALYSIS, vol. 37 (2017), p. 519-541, ISSN: 0272-4979, doi: 10.1093/imanum/drw013 -Impact Factor 1.703
8.	DE MARCHI, STEFANO, Iske, Armin, Sironi, Amos (2016). Kernel-based Image Reconstruction from Scattered Radon Data. DOLOMITES RESEARCH NOTES ON APPROXIMATION, vol. 9, p. 19-31, ISSN: 2035-6803, doi: 10.14658/pupj-drna-2016-Special_Issue-4
9.	Stefano De Marchi, Gabriele Santin (2015). Fast computation of orthonormal basis for RBF spaces through Krylov space methods. BIT, vol. 55, p. 949-966, ISSN: 0006-3835, doi: 10.1007/s10543-014-0537-6 -Impact Factor 1.167
10.	Cavoretto R, De Marchi S, De Rossi A, Perracchione E, Santin G (2015). RBF approximation of large datasets by partition of unity and local stabilization. In: (a cura di): J. Vigo-Aguiar, Proceedings of the 15th International Conference on Computational and Mathematical Methods in Science and Engineering. vol. I-II-III-IV, p. 317-326, CMMSE, ISBN: 978-84-617-2230-3
11.	Stefano De Marchi, Konstantin Usevich (2014). On certain multivariate Vandermonde determinants whose variables separate. LINEAR ALGEBRA AND ITS APPLICATIONS, vol. 449, p. 17-27, ISSN: 0024-3795, doi: 10.1016/j.laa.2014.01.034 -Impact Factor .939
12.	S. De Marchi, A. Sommariva, M. Vianello (2014). Multivariate Christoffel functions and hyperinterpolation. DOLOMITES RESEARCH NOTES ON APPROXIMATION, vol. 7, p. 26-33, ISSN: 2035-6803
13.	Stefano De Marchi, Marco Vianello (2013). Polynomial approximation on pyramids, cones and solids of rotation. DOLOMITES RESEARCH NOTES ON APPROXIMATION, vol. 6, p. 20-26, ISSN: 2035-6803
14.	Stefano De Marchi, Gabriele Santin (2013). A new stable basis for radial basis function interpolation. JOURNAL OF COMPUTATIONAL AND APPLIED MATHEMATICS, vol. 253, p. 1-13, ISSN: 0377-0427, doi: 10.1016/j.cam.2013.03.048 -Impact Factor 1.077
15.	Bos Len, S. DE MARCHI, Hormann Kai, Klein Georges (2012). On the Lebesgue constant of barycentric rational interpolation at equidistant nodes. NUMERISCHE MATHEMATIK, vol. 121, p. 461-471, ISSN: 0029-599X, doi: 10.1007/s00211-011-0442-8 -Impact Factor 1.329
16.	Len Bos, Stefano DE MARCHI, Kai Hormann (2011). On the Lebesgue constant of Berrut's rational interpolant at equidistant nodes. JOURNAL OF COMPUTATIONAL AND APPLIED MATHEMATICS, vol. 236, p. 504-510, ISSN: 0377-0427, doi: 10.1016/j.cam.2011.04.004 -Impact Factor 1.112
17.	L.BOS, S.DE MARCHI, A. SOMMARIVA, M.VIANELLO (2011). Weakly Admissible Meshes and Discrete Extremal Sets. NUMERICAL MATHEMATICS, vol. 4, p. 1-12, ISSN: 1004-8979 -Impact Factor .692
18.	CALIARI, MARCO, DE MARCHI, STEFANO, SOMMARIVA, ALVISE, VIANELLO, MARCO (2011). Padua2DM: fast interpolation and cubature at the Padua points in Matlab/Octave. NUMERICAL ALGORITHMS, vol. 56, p. 45-60, ISSN: 1017-1398, doi: 10.1007/s11075-010-9373-1 -Impact Factor 1.042
19.	L. BOS, S. DE MARCHI, A. SOMMARIVA, M. VIANELLO (2011). On Multivariate Newton Interpolation at Discrete Leja Points. DOLOMITES RESEARCH NOTES ON APPROXIMATION, vol. 4, p. 15-20, ISSN: 2035-6803
20.	L. Bos, DE MARCHI, STEFANO, SOMMARIVA, ALVISE, VIANELLO, MARCO (2010). Computing multivariate Fekete and Leja points by numerical linear algebra. SIAM JOURNAL ON NUMERICAL ANALYSIS, vol. 48, p. 1984-1999, ISSN: 0036-1429, doi: 10.1137/090779024 -Impact Factor 1.664

21. DE MARCHI STEFANO, ROBERT SCHABACK (2010). Stability of Kernel-Based Interpolation. ADVANCES IN COMPUTATIONAL MATHEMATICS, vol. 32, p. 155-161, ISSN: 1019-7168, doi: 10.1007/s10444-008-9093-4 -Impact Factor 1.438

22. Stefano De Marchi, Robert Schaback (2009). Nonstandard Kernels and their Applications. DOLOMITES RESEARCH NOTES ON APPROXIMATION, vol. 2, p. 16-43, ISSN: 2035-6803

23. BOS, LEONARD PETER, DE MARCHI, Stefano (2008). Univariate Radial Basis Functions with Compact Support Cardinal Functions. EAST JOURNAL ON APPROXIMATIONS, vol. 14, p. 69-80, ISSN: 1310-6236

24. VIANELLO, MARCO, DE MARCHI, STEFANO, VIANELLO, MARCO (2008). Algorithm 886: Padua2D-Lagrange Interpolation at Padua Points on Bivariate Domains. ACM TRANSACTIONS ON MATHEMATICAL SOFTWARE, vol. 35, ISSN: 0098-3500, doi: 10.1145/1391989.1391994 -Impact Factor 2.197

25. CALIARI M, DE MARCHI S, VIANELLO M. (2008). Hyperinterpolation in the cube. COMPUTERS & MATHEMATICS WITH APPLICATIONS, vol. 55, p. 2490-2497, ISSN: 0898-1221, doi: 10.1016/j.camwa.2007.10.003 -Impact Factor .997

26. MARCO CALIARI, STEFANO DE MARCHI, MARCO VIANELLO (2008). Bivariate Lagrange interpolation at the Padua points: Computational aspects. JOURNAL OF COMPUTATIONAL AND APPLIED MATHEMATICS, vol. 221, p. 284-292, ISSN: 0377-0427, doi: 10.1016/j.cam.2007.10.027 -Impact Factor 1.048

27. Len Bos, Stefano De Marchi, Marco Vianello, Yuan Xu (2007). Bivariate Lagrange interpolation at the Padua points: the ideal theory approach. NUMERISCHE MATHEMATIK, vol. 108, p. 43-57, ISSN: 0029-599X, doi: 10.1007/s00211-007-0112-z -Impact Factor 1.376

28. BOS L, CALIARI, MARCO, DE MARCHI, STEFANO, VIANELLO, MARCO (2006). Bivariate interpolation at Xu points: results, extensions and applications. ELECTRONIC TRANSACTIONS ON NUMERICAL ANALYSIS, vol. 25, p. 1-16, ISSN: 1068-9613 -Impact Factor .738

29. L. Bos, M. Caliari, DE MARCHI, STEFANO, VIANELLO, MARCO, Y. Xu (2006). Bivariate Lagrange interpolation at the Padua points: the generating curve approach. JOURNAL OF APPROXIMATION THEORY, vol. 143, p. 15-25, ISSN: 0021-9045, doi: 10.1016/j.jat.2006.03.008 -Impact Factor .5

30. Marco Caliari, Stefano De Marchi, Marco Vianello (2005). Bivariate polynomial interpolation on the square at new nodal sets. APPLIED MATHEMATICS AND COMPUTATION, vol. 165, p. 261-274, ISSN: 0096-3003, doi: 10.1016/j.amc.2004.07.001

31. DE MARCHI, Stefano, R. Schaback, H. Wendland (2005). Near-Optimal Data-independent Point Locations for Radial Basis Function Interpolation. ADVANCES IN COMPUTATIONAL MATHEMATICS, vol. 23, p. 317-330, ISSN: 1019-7168

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1.10 Componenti il Gruppo di Ricerca
Research-Unit Participants

1.10.0 Professori e ricercatori anche a tempo determinato dell'Università di Padova
University of Padua Researchers

nº	Cognome	Nome	Dipartimento	Area scientifica di ateneo	Qualifica	Settore	Mesi/Persona(*) Primo anno	Mesi/Persona(*) Secondo anno	Stato della risposta
1.	CAMPI	Cristina	DIP. MEDICINA - DIMED	01 - Mathematics	Ricercatore a t.d. - t.pieno (art. 24 c.3-a L. 240/10)	MAT/08	4	4	
2.	CECCHIN	Diego	DIP. MEDICINA - DIMED	07 - Medicine	Professore Associato (L. 240/10)	MED/36	3	3	
3.	VIANELLO	Marco	DIP. MATEMATICA "TULLIO LEVI CIVITA" - DM	01 - Mathematics	Professore Ordinario (L. 240/10)	MAT/08	4	4	
4.	DE MARCHI	Stefano	DIP. MATEMATICA "TULLIO LEVI CIVITA" - DM	01 - Mathematics	Professore Associato confermato	MAT/08	4	4	

1.10.1 Professori a contratto di cui all'art. 23 della legge 240/2010, altro Personale dell'Università di Padova anche a tempo determinato (personale tecnico-amministrativo, Dirigenti e CEL)
Other University of Padua Staff

nº	Nome	Dipartimento	Qualifica	Mesi/Persona(*) Primo anno	Mesi/Persona(*) Secondo anno

1.10.2 Titolari di assegni di ricerca dell'Università di Padova
University of Padua Research Grants

nº	Cognome	Nome	Dipartimento	Area scientifica di ateneo	Mesi/Persona(*) Primo anno	Mesi/Persona(*) Secondo anno
1.	FACCA	Enrico	DIP. MATEMATICA "TULLIO LEVI CIVITA" - DM	01 - Scienze Matematiche	4	4
2.	PERRACCHIONE	Emma	DIP. MATEMATICA "TULLIO LEVI CIVITA" - DM	01 - Scienze Matematiche	4	4
3.	PIAZZON	Federico	DIP. MATEMATICA "TULLIO LEVI CIVITA" - DM	01 - Scienze Matematiche	4	4
4.	POGGIALI	Davide	DIP. MATEMATICA "TULLIO LEVI CIVITA" - DM	01 - Scienze Matematiche	4	4

1.10.3 Studenti di Dottorato di Ricerca dell'Università di Padova
University of Padua Students phD Students

nº	Cognome	Nome	Dipartimento	Area scientifica di ateneo	Qualifica	Mesi/Persona(*) Primo anno	Mesi/Persona(*) Secondo anno
1.	MARCHETTI	Francesco	DIP. SALUTE DELLA DONNA E DEL BAMBINO - SDB	07 - Scienze Mediche	Dottorando	3	3

1.10.4 Professori, ricercatori anche a tempo determinato di altre Università
Other Universities Researchers

nº	Cognome	Nome	Università	Area scientifica di ateneo	Dipartimento	Qualifica	Settore	Mesi/Persona(*) Primo anno	Mesi/Persona(*) Secondo anno

1.10.5 Dipendenti di altre amministrazioni pubbliche, di enti pubblici o privati, di imprese, di istituzioni straniere, soggetti esterni in possesso di specifiche competenze nel campo della ricerca
Other Personnel

nº	Cognome	Nome	Ente	Qualifica	Mesi/Persona(*) Primo anno	Mesi/Persona(*) Secondo anno
1.	ERB	WOLFGANG	University of Hawaii at Manoa	Post-doc	3	3
2.	BAUMAN	BRIAN J.	Lawrence Livermore National Laboratory	Researcher	4	4

2.1.0 Pubblicazioni scientifiche più significative dei componenti il gruppo di ricerca (docenti dell'ateneo di Padova)
Relevant publications of the Research Group (Universtity of Padua Researchers)

nº	Pubblicazioni
1.	Gaspare Da Fies, SOMMARIVA, ALVISE, VIANELLO, MARCO (2013). Algebraic cubature by linear blending of elliptical arcs. APPLIED NUMERICAL MATHEMATICS, vol. 74, p. 49-61, ISSN: 0168-9274, doi: 10.1016/j.apnum.2013.08.003 Impact factor 1.036
2.	SOMMARIVA, ALVISE, VIANELLO, MARCO (2015). Compression of multivariate discrete measures and applications. NUMERICAL FUNCTIONAL ANALYSIS AND OPTIMIZATION, vol. 36, p. 1198-1223, ISSN: 0163-0563, doi: 10.1080/01630563.2015.1062394 Impact factor .649
3.	VIANELLO, MARCO (2016). Compressed sampling inequalities by Tchakaloff's theorem. MATHEMATICAL INEQUALITIES & APPLICATIONS, vol. 19, p. 395-400, ISSN: 1331-4343, doi: 10.7153/mia-19-31 Impact factor .603
4.	BOS, LEONARD PETER, DE MARCHI, STEFANO, VIANELLO, MARCO (2016). Trivariate polynomial approximation on Lissajous curves. IMA JOURNAL OF NUMERICAL ANALYSIS, vol. 37 (2017), p. 519-541, ISSN: 0272-4979, doi: 10.1093/imanum/drw013 Impact factor 1.703
5.	Gentile M., Sommariva A., Vianello M (2017). Polynomial approximation and quadrature on geographic rectangles. APPLIED MATHEMATICS AND COMPUTATION, vol. 297, p. 159-179, ISSN: 0096-3003, doi: 10.1016/j.amc.2016.08.014
6.	SOMMARIVA, ALVISE, VIANELLO, MARCO (2017). Numerical hyperinterpolation over nonstandard planar regions. MATHEMATICS AND COMPUTERS IN SIMULATION, vol. 141, p. 110-120, ISSN: 0378-4754, doi: 10.1016/j.matcom.2016.07.009
7.	Sudhakar Y, Sommariva Alvise, Vianello Marco, Wall W.A. (2017). On the Use of Compressed Polyhedral Quadrature Formulas in Embedded Interface Methods. SIAM JOURNAL ON SCIENTIFIC COMPUTING, vol. 39, p. 571-587, ISSN: 1064-8275, doi: 10.1137/16M1085206 Impact factor 2.195
8.	Leopardi, Paul, SOMMARIVA, ALVISE, VIANELLO, MARCO (2017). Optimal polynomial meshes and Caratheodory-Tchakaloff submeshes on the sphere. DOLOMITES RESEARCH NOTES ON APPROXIMATION, vol. 10, p. 18-24, ISSN: 2035-6803

9.	Piazzon Federico, Sommariva Alvise, Vianello Marco (2017). Caratheodory-Tchakaloff Least Squares. In: 2017 International Conference on Sampling Theory and Applications (SampTA). p. 672-676, IEEE, ISBN: 978-1-5386-1565-2, Tallinn, Estonia., July 3 - 7, 2017, doi: 10.1109/SAMPTA.2017.8024337
10.	PIAZZON, FEDERICO, SOMMARIVA, ALVISE, VIANELLO, MARCO (2017). Caratheodory-Tchakaloff Subsampling. DOLOMITES RESEARCH NOTES ON APPROXIMATION, vol. 10, p. 5-14, ISSN: 2035-6803, doi: 10.14658/pupj-drna-2017-1-2
11.	A. Pascarella, A. Sorrentino, C. Campi, M. Piana (2010). Particle filtering, beamforming and multiple signal classification for the analysis of magnetoencephalography time series: a comparison of algorithms. INVERSE PROBLEMS AND IMAGING, vol. 4, p. 169-190, ISSN: 1930-8337, doi: 10.3934/ipi.2010.4.169 Impact factor 1.403
12.	C. Campi, A. Pascarella, A. Sorrentino, M. Piana (2008). A Rao-Blackwellized particle filter for magnetoencephalography. INVERSE PROBLEMS, vol. 24, p. 025023, ISSN: 0266-5611, doi: 10.1088/0266-5611/24/2/025023 Impact factor 1.912
13.	Campi Cristina, Perasso Annalisa, Beltrametti Mauro C., Piana Michele, Sambuceti Gianmario, Massone Anna Maria (2016). HT-BONE: a graphical user interface for the identification of bone profiles in CT images via extended Hough transform. In: Progress in Biomedical Optics and Imaging - Proceedings of SPIE. PROGRESS IN BIOMEDICAL OPTICS AND IMAGING, p. 1-10, SPIE, ISBN: 978-151060019-5, ISSN: 1605-7422, San Diego,United States, da 01/03/2016 a 03/03/2016, doi: 10.1117/12.2216375
14.	Perasso Annalisa, Campi Cristina, Massone Anna Maria, Beltrametti Mauro C. (2015). Spinal canal and spinal marrow segmentation by means of the hough transform of special classes of curves. In: Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics). p. 590-600, Springer Verlag, ISBN: 9783319232300, ita, 2015, doi: 10.1007/978-3-319-23231-7_53
15.	MASSONE A M, Campi C, Beltrametti M C, Marini C (2017). FDG-PET and the assessment of spinal cord metabolism in Amyotrophic Lateral Sclerosis (ALS). In: 2016 IEEE Nuclear Science Symposium, Medical Imaging Conference and Room-Temperature Semiconductor Detector Workshop (NSS/MIC/RTSD), 2016. IEEE, ISBN: 978-1-5090-1642-6, doi: 10.1109/NSSMIC.2016.8069573
16.	Federico Benvenuto, Michele Piana, Cristina Campi, Anna Maria Massone (2018). A Hybrid Supervised/Unsupervised Machine Learning Approach to Solar Flare Prediction. THE ASTROPHYSICAL JOURNAL, vol. 853, p. 1-9, ISSN: 0004-637X Impact factor 5.533
17.	A. Sorrentino, L. Parkkonen, A. Pascarella, C. Campi, M. Piana (2009). Dynamical MEG source modeling with multi-target bayesian tracking. HUMAN BRAIN MAPPING, vol. 30, p. 1911-1921, ISSN: 1065-9471, doi: 10.1002/hbm.20786 Impact factor 6.256
18.	S. Pursiainen, A. Sorrentino, C. Campi, M. Piana (2011). Forward simulation and inverse dipole localization with the lowest Raviart-Thomas elements for electroencephalography. INVERSE PROBLEMS, vol. 27, p. 045003, ISSN: 0266-5611, doi: 10.1088/0266-5611/27/4/045003 Impact factor 1.88
19.	CAMPI, CRISTINA, A. Pascarella, SORRENTINO, ALBERTO, PIANA, MICHELE (2011). Highly Automated Dipole EStimation (HADES). COMPUTATIONAL INTELLIGENCE AND NEUROSCIENCE, vol. 2011, p. 982185, ISSN: 1687-5265, doi: 10.1155/2011/982185
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21.	FIZ, FRANCESCO, MARINI, CECILIA, CAMPI, CRISTINA, MASSONE , Anna Maria, Podestà, Marina, BOTTONI, GIANLUCA, PIVA, ROBERTA, BONGIOANNI, FRANCESCA, Bacigalupo, Andrea, PIANA, MICHELE, SAMBUCETI, GIANMARIO, FRASSONI, FRANCESCO (2015). Allogeneic cell transplant expands bone marrow distribution by colonizing previously abandoned areas: An FDG PET/CT analysis. BLOOD, vol. 125, p. 4095-4102, ISSN: 0006-4971, doi: 10.1182/blood-2015-01-618215 Impact factor 11.847
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23.	Perasso Annalisa, Campi Cristina, Toraci Cristian, Benvenuto Francesco, Piana Michele, Massone Anna Maria (2015). Application of Possibilistic C-Means for fault detection in Nuclear Power Plant data. JOURNAL OF ENGINEERING FOR GAS TURBINES AND POWER, vol. 137, p. 062901, ISSN: 0742-4795, doi: 10.1115/1.4028809
24.	Marini, C., Cistaro, A., CAMPI, CRISTINA, Calvo, A., Caponnetto, C., NOBILI, FLAVIO MARIANO, Fania, P., BELTRAMETTI, MAURO CARLO, Moglia, C., Novi, G., Buschiazzo, A., Perasso, A., Canosa, A., Scialò, C., POMPOSELLI, ELENA, Massone, A. M., Bagnara, M. C., Cammarosano, S., Bruzzi, P. L., Morbelli, S, ., SAMBUCETI, GIANMARIO, MANCARDI, GIOVANNI LUIGI, PIANA, MICHELE, Chiò, A. (2016). A PET/CT approach to spinal cord metabolism in amyotrophic lateral sclerosis. EUROPEAN JOURNAL OF NUCLEAR MEDICINE AND MOLECULAR IMAGING, p. 1-11, ISSN: 1619-7070, doi: 10.1007/s00259-016-3440-3
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26.	CECCHIN, DIEGO, CHONDROGIANNIS S, DELLA PUPPA A, ROTILIO A, ZUSTOVICH F, MANARA R, GARDIMAN M, BERTI F, ZUCCHETTA P, CAROLLO C, BUI, FRANCO (2009). Presurgical Tc-99m-sestamibi brain SPET/CT versus SPET: a comparison with MRI and histological data in 33 patients with brain tumours. NUCLEAR MEDICINE COMMUNICATIONS, vol. 30, p. 660-668, ISSN: 0143-3636, doi: 10.1097/MNM.0b013e32832ea9b7 Impact factor 1.315
27.	TOLDO I, CECCHIN D, SARTORI S, CALDERONE M, MARDARI R, CATTELAN F, LAVERDA AM, P. DRIGO, BATTISTELLA PA (2011). Multimodal neuroimaging in a child with sporadic hemiplegic migraine: A contribution to understanding pathogenesis.. CEPHALALGIA, vol. 31, p. 751-756, ISSN: 0333-1024, doi: 10.1177/0333102410392068 Impact factor 3.43
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	CLINICAL ONCOLOGY, vol. 29, p. 171-174, ISSN: 0732-183X, doi: 10.1200/JCO.2010.31.7131 **Impact factor 18.372**
29.	**D'Ascenzo C, Cecchin D, Santelli L, Palmieri A, Gaiani A, Querin G, Cima V, Volpe M, Bello L, Bui F, Cagnin A, Angelini C, Pegoraro E, Sorarù G (2012). Parkinson-like features in ALS with predominant upper motor neuron involvement. AMYOTROPHIC LATERAL SCLEROSIS, vol. 13, p. 137-143, ISSN: 1748-2968, doi: 10.3109/17482968.2011.603732** **Impact factor 2.369**
30.	**LOMBARDI, GIUSEPPE, F. Zustovich, P. Farina, A. Della Puppa, R. Manara, CECCHIN, DIEGO, A. Brunello, A. Cappetta, V. Zagonel (2011). Neoplastic Meningitis from Solid Tumors: New Diagnostic and Therapeutic Approaches. THE ONCOLOGIST, vol. 16, p. 1175-1188, ISSN: 1083-7159, doi: 10.1634/theoncologist.2011-0101** **Impact factor 3.91**
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32.	**JELCIC N, De PELLEGRIN S, CECCHIN D, Della PUPPA A, CAGNIN A. (2013). Cognitive improvement after cranioplasty: A possible volume transmission-related effect.** **. ACTA NEUROCHIRURGICA, vol. 155, p. 1597-1599, ISSN: 0001-6268, doi: 10.1007/s00701-012-1519-6** **Impact factor 1.788**
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35.	**CECCHIN, DIEGO, SCHIORLIN, ILARIA, DELLA PUPPA, ALESSANDRO, LOMBARDI, GIUSEPPE, ZUCCHETTA, PIETRO, BODANZA, VALENTINA, Gardiman MP, ROLMA, GIUSEPPE, FRIGO, ANNA CHIARA, BUI, FRANCO (2014). Assessing Response Using (99m) Tc-MIBI Early after Interstitial Chemotherapy with Carmustine-Loaded Polymers in Glioblastoma Multiforme: Preliminary Results.. BIOMED RESEARCH INTERNATIONAL, vol. 2014, ISSN: 2314-6133, doi: 10.1155/2014/684383** **Impact factor 1.579**
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49.	**DELLA PUPPA, ALESSANDRO, LOMBARDI, GIUSEPPE, ROSSETTO, MARTA, RUSTEMI, ORIELA, BERTI, FRANCO, CECCHIN, DIEGO, Gardiman, Marina Paola, ROLMA, GIUSEPPE, PERSANO, LUCA, ZAGONEL, VITTORINA, SCIENZA, RENATO (2017). Outcome of patients affected by newly diagnosed glioblastoma undergoing surgery assisted by 5-aminolevulinic acid guided resection followed by BCNU wafers implantation: a 3-year follow-up. JOURNAL OF NEURO-ONCOLOGY, vol. 131, p. 331-340, ISSN: 0167-594X, doi: 10.1007/s11060-016-2301-z** **Impact factor 2.98**
50.	**Tiraboschi Pietro, Corso Angelo, Guerra Ugo Paolo, Nobili Flavio, Piccardo Arnoldo, Calcagni Maria Lucia, Volterrani Duccio, Cecchin Diego, Tettamanti Mauro, Antelmi Luigi, Vidale Simone, Sacco Leonardo, Merello Maria, Stefanini Stefano, Micheli Anna, Vai Paola, Capitanio Selene, Gabanelli Sara Vincenzina, Riva Riccardo, Pinto Patrizia, Biffi Ave Maria, Muscio Cristina (2016). 123I-2β-carbomethoxy-3β-(4-iodophenyl)-N-(3-fluoropropyl) nortropane single photon emission computed tomography and 123I-metaiodobenzylguanidine myocardial scintigraphy in differentiating dementia with lewy bodies from other dementias: A comparative study. ANNALS OF NEUROLOGY, vol. 80, p. 368-378, ISSN: 0364-5134, doi: 10.1002/ana.24717** **Impact factor 9.89**
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52.	**CECCHIN, DIEGO, PALOMBIT, ALESSANDRO, CASTELLARO, MARCO, SILVESTRI, ERICA, BUI, FRANCO, Barthel, Henryk, Sabri, Osama, CORBETTA, MAURIZIO, BERTOLDO, ALESSANDRA (2017). Brain PET and functional MRI: why simultaneously using hybrid PET/MR systems?. THE QUARTERLY JOURNAL OF NUCLEAR MEDICINE AND MOLECULAR IMAGING, vol. 4, p. 345-359, ISSN: 1827-1936, doi: 10.23736/S1824-4785.17.03008-4**
53.	**Nardetto, L., Zoccarato, M., Santelli, L., Tiberio, I., Cecchin, D., Giometto, B. (2017). 18F-FDG PET/MRI in cryptogenic new-onset refractory status epilepticus: a potential marker of disease location, activity and prognosis?. JOURNAL OF THE NEUROLOGICAL SCIENCES, vol. 381, p. 100-102, ISSN: 0022-510X, doi: 10.1016/j.jns.2017.08.021** **Impact factor 2.295**
54.	**Caporali, Leonardo, Bello, Luca, Tagliavini, Francesca, La Morgia, Chiara, Maresca, Alessandra, Di Vito, Lidia, Liguori, Rocco, Valentino, Maria Lucia, Cecchin, Diego, Pegoraro, Elena, Carelli, Valerio (2018). DGUOK recessive mutations in patients with CPEO, mitochondrial myopathy, parkinsonism and mtDNA deletions. BRAIN, vol. 141, p. e3, ISSN: 0006-8950, doi: 10.1093/brain/awx301** **Impact factor 10.292**

2.1.1 Pubblicazioni scientifiche più significative dei componenti il gruppo di ricerca (altri partecipanti al progetto) Relevant publications of the Research Group (Other participants)

[1] Luca Bergamaschi, Enrico Facca, Ángeles Martínez Calomardo, and Mario Putti.
Spectral preconditioners for the efficient numerical solution of a continuous branched transport model.
J. Comput. Appl. Math., 2018, available online.

[2] Enrico Facca, Franco Cardin, and Mario Putti.
Towards a stationary Monge-Kantorovich dynamics: The physarum polycephalum experience.
SIAM J. Appl. Math. 78(2):651-676 (2018).

[3] A Favaretto, D Poggiali, A Lazzarotto, G Rolma, F Causin, P Gallo
The Parallel Analysis of Phase Sensitive Inversion Recovery (PSIR) and Double Inversion Recovery (DIR) Images Significantly Improves the Detection of Cortical Lesions in Multiple Sclerosis (MS) since Clinical Onset
PLoS One 10 (5), e0127805 16 2015

[4] D Cecchin, D Poggiali, L Riccardi, P Turco, F Bui, S De Marchi
Analytical and experimental FWHM of a gamma camera: theoretical and practical issues
PeerJ 3, e722 4 2015

[5] D Cecchin, H Barthel, D Poggiali, A Cagnin, S Tiepolt, P Zucchetta, et al.
A new integrated dual time-point amyloid PET/MRI data analysis method
European Journal of Nuclear Medicine and Molecular Imaging, pp 1-13 2 2017

[6] A Favaretto, A Lazzarotto, D Poggiali, G Rolma, F Causin, F Rinaldi, et al.
MRI-detectable cortical lesions in the cerebellum and their clinical relevance in multiple sclerosis
Multiple Sclerosis Journal 22 (4), 494-501 12 2016

[7] M Puthenparampil, D Poggiali, F Causin, G Rolma, F Rinaldi, P Perini, et al.
Cortical relapses in multiple sclerosis
Multiple Sclerosis Journal 22 (9), 1184-1191 9 2016

[8] R. Cavoretto, A. De Rossi, E. Perracchione,
Optimal selection of local approximants in RBF-PU interpolation using bivariate LOOCV,
J. Sci. Comput. 74 (2018), pp. 1Â—22.

[9] A. De Rossi, E. Perracchione,
Positive constrained approximation via RBF-based partition of unity method,
J. Comput. Appl. Math. 319 (2017), pp. 338Â—351.

[10] R. Cavoretto, S. De Marchi, A. De Rossi, E. Perracchione, G. Santin,
Partition of unity interpolation using stable kernel-based techniques,
Appl. Numer. Math. 116 (2017), pp. 95--107.

[11] R. Cavoretto, A. De Rossi, E. Perracchione,
Efficient computation of partition of unity interpolants through a block-based searching technique,
Comput. Math. Appl. 71 (2016), pp. 2568--2584.

[12] R. Cavoretto, A. De Rossi, E. Perracchione, E. Venturino,
Robust approximation algorithms for the detection of attraction basins in dynamical systems,
J. Sci. Comput. 68 (2015), pp. 395—415.

[13] L. P. Bos, N. Levenberg, S. Ma'u and F. Piazzon
A weighted extremal function and equilibrium measure
Math. Scand., to appear. Accepted 01/30/2017.

[14] F. Piazzon
Some results on the rational Bernstein Markov property in the complex plane
Computational Methods and Function Theory DOI: 10.1007/s40315-017-0194-2

[15] F. Piazzon and M. Vianello
Jacobi norming meshes
Math. Inequal. Appl. 19 (2016), 1089--1095

[16] F. Piazzon
Optimal Polynomial Admissible Meshes on Some Classes of Compact Subsets of R^d (pdf)
J. Approx. Theory 207, July 2016, Pages 241-264

[17] L. P. Bos, A. Narayan, N. Levenberg and F. Piazzon
An orthogonality property of Legendre polynomials
Constr. Approx., published online 04 January 2016.

[18] S. De Marchi, F. Piazzon, A. Sommariva and M. Vianello
Polynomial Meshes: Computation and Approximation
Proceedings of CMMSE 2015, 414--425

[19] T. Bloom, N. Levenberg, F. Piazzon and F. Wielonsky
Bernstein Markov: a survey.
Dolomites Res. Notes Approx. DRNA 8 (2015), 75--91

[20] F. Piazzon and M. Vianello
Sub-optimal polynomial meshes on planar Lipschitz domains
Numer. Funct. Anal. Optim. 35 (2014)

[21] S. De Marchi, W. Erb and F. Marchetti
Spectral filtering for the reduction of the Gibbs phenomenon of polynomial approximation methods on Lissajous curves with applications in MPI
Dolomites Res. Notes Approx. 10 (2017), pp. 128--137.

[22] Erb, W., Kaethner, C., Ahlborg, M. and Buzug, T.M.
Bivariate Lagrange interpolation at the node points of non-degenerate Lissajous curves Numer. Math. 133, 4 (2016), 685-705

[23] Erb, W., Kaethner, C., Dencker, P. and Ahlborg, M.
A survey on bivariate Lagrange interpolation on Lissajous nodes
Dolomites Research Notes on Approximation 8 (Special issue) (2015), 23-36.

[24] Kaethner, C., Erb, W., Ahlborg, M., Szwargulski, P., Knopp, T. and Buzug, T. M.
Non-Equispaced System Matrix Acquisition for Magnetic Particle Imaging based on Lissajous Node Points
IEEE Transactions on Medical Imaging 35, 11 (2016), 2476-2485.

[25] Schmiester, L., Moddel, M., Erb, W. and Knopp, T.
Direct Image Reconstruction of Lissajous Type Magnetic Particle Imaging Data using Chebyshev-based Matrix Compression
IEEE Transactions on Computational Imaging 3, 4 (2017), 671-681

[26] Pardini, T., Poyneer, L.A., McCarville, T.J., Macintosh, B., Bauman, B., Pivovaroff, M.J.
The adaptive x-ray optic project at the Lawrence Livermore National Laboratory
Journal of Physics: Conference Series, 493(1) (2014) Art. 012022

[27] Poyneer, L.A., Palmer, D.W., Macintosh, B., Savransky, D., Sadakuni, N., Thomas, S., Véran, J.-P., Follette, K.B., Greenbaum, A.Z., Ammons, S.M., Bailey, V.P., Bauman, B. et al.
Performance of the Gemini planet imager's adaptive optics system
Applied Optics 55(2) (2016), 323-340

Submitted

- Enrico Facca, Sara Daneri, Franco Cardin, and Mario Putti. Numerical solution of Monge-
Kantorovich equations via a dynamic formulation. SIAM Journal on Scientific Computing, Submitted (2017)

2.2 Curriculum scientifico dei Componenti il Gruppo di Ricerca
Participants' curriculum

MARCO VIANELLO: SCIENTIFIC CURRICULUM

* Born in Venice on October 26, 1961

* 1st Degree in Mathematics, Univ. of Padova, 1987

* Ph.D. in Computational Mathematics, 1992 (consortium: BO-PD-TS-UD),
supervisor Prof. R. Spigler

* INdAM fellowship (1991-1993) * Research assistant of Numerical Analysis at the Faculty of Science, Univ. of Padova (1993-2000)

* Associate professor of Numerical Analysis at the Dept. of Mathematics of the Univ. of Padova (2000-2017)

* Full professor of Numerical Analysis at the Dept. of Mathematics of the Univ. of Padova (May 2017-present)

* personal web page: http://www.math.unipd.it/~marcov

RESEARCH RESULTS

* Author of over 120 papers in Numerical Analysis, Approximation Theory and Mathematical Analysis (27 co-authors, 54 journals) and of several software packages

COORDINATION ACTIVITY

* Co-founder of the CAA: Padova-Verona Research Group on Constr. Approx.
and Appl. (http://www.math.unipd.it/~marcov/CAA.html)

* Supervisor of 3 Ph.D. in Mathematical Sciences - Univ. of Padova:
A. Sommariva 1999, M. Caliari 2002, F. Piazzon 2016

* Supervisor of 4 post-docs: A. Sommariva 2000-04, A. Martinez 2005-06,
M. Caliari 2006-07, F. Piazzon 2017-18

* Coordinator of a University Biennial Project (Padova) (2003-04,
funding: 35 kEuro, people: 8)

* Local coordinator of a PRIN 2003 (2004-05, national coord. L. Lopez,
Bari; funding: 20 kEuro, people: 4)

* Coordinator of a national INdAM-GNCS project (2012, funding:
5 kEuro, people: 5)

* Scientific Area Committee (2004-05) and Committee of the Doctoral
School in Mathematical Sciences (2005-10) Univ. of Padova

* Organizer of 4 international conferences and 9 workshops on
Approximation Theory (Canazei, 2006-2018)

* Managing editor of the journal Dolomites Res. Notes on Approx.,
published by Padova Univ. Press and indexed on: ISI, MATHSCINET, SCOPUS

DIEGO CECCHIN: SCIENTIFIC CURRICULUM

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Gender: M

Work experience
Dates 01/10/2015 Associate Professor of Nuclear Medicine at the University/Hospital of Padova
Dir. Postgraduate School of Nuclear Medicine

Occupation or position held 01/05/2002 -> 01/010/2015
Confirmed Researcher at the University of Padova (“Aggregated Professor”)

Main activities and responsibilities
° Full time staff physician at the Nuclear Medicine Service Institute of the University Hospital of Padua
° He is associate professor of Nuclear Medicine at the: Postgraduate School of Nuclear Medicine, School of Radiology and Nuclear Medicine Technology, School of Medicine,Postgraduate School of Neurosciences.
° Biomedical Research in Nuclear Medicine
° HIS-RIS-PACS administration of the Nuclear Medicine Service, University of Padova.

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Type of business or sector: Medical / University teaching

Selected Pubblications:
1. Cecchin D, Barthel H, Poggiali D, Cagnin A, Tiepolt S, Zucchetta P, Turco P, Gallo P, Frigo AC, Sabri O, Bui F. A new integrated dual time-point amyloid PET/MRI data analysis method. Eur J Nucl Med Mol Imaging. 2017 Jul 4. doi: 10.1007/s00259-017-3750-0. [Epub ahead of print]
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5. Cecchin D, Zucchetta P, Faggin P, Bolla E, Bui F 99MO/99MTC GENERATOR SHORTAGE: FREE, WEB-BASEDSOFTWARE. J Nucl Med. 2010 Aug;51(8):14N-15N.

CRISTINA CAMPI: SCIENTIFIC CURRICULUM

Cristina Campi was born in Genoa (Italy) in 1982. She received her M.Sc. in Mathematics in 2006 followed by a Ph.D. in Mathematics and Applications in 2010 from the Università degli Studi di Genova, Italy. From 2010 to 2011 she was part as Postdoctoral Fellow of the Neuroinformatics Group at the Department of Computer Science, University of Helsinki Finland. In 2012 she was a Postdoc at the Department of Neuroscience, Università di Parma, Italy under the supervision of Professor Giacomo Rizzolatti.
She received post-doc fellowships from the Italian National Research Council (CNR) and Università di Roma La Sapienza from 2013 to 2016. From January 2017 to February 2018 she was a fixed-term researcher at CNR Institute SPIN and a member of the Horizon2020 Project Flarecast (http://flarecast.eu). Since March 2018 she

is a Research Fellow in Numerical Analysis at the Department of Medicine, Univerisità di Padova, Italy. Her research interests include medical image analysis, neuroimaging and computational neuroscience.

A complete list of publications can be found at: https://sites.google.com/view/cristina-campi/home/publications

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Within her research activity she contributed to the development of HADES software http://mida.dima.unige.it/g_software_hades.html for the analysis of neuromagnetic signals by means of Bayesian tracking and HT-BONE software http://mida.dima.unige.it/g_software_htbone.html for the pattern recognition of curve in images, currently employed at the Nuclear Medicine Department at IRCCS San Martino (Genova).

ENRICO FACCA

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Current Position (since May-2018):
Research fellowship - University of Padova - Supervisor: Prof. Mario Putti

Previous positions (Gen-2018 Apr-2018):
Scholarship researcher - University of Padova - Supervisor: Prof. Mario Putti

Education:
(2018) Mathematics PhD - University of Padova - Supervisors: Prof. Mario Putti, Franco Cardin
(2014) Mathematics Master Degree - University of Padova - Supervisors: Prof. Mario Putti, Franco Cardin

List of Publications:
(1) : "Towards a Stationary Monge-Kantorovich Dynamics: The
Physarum Polycephalum Experience" (Enrico Facca, Franco
Cardin and Mario Putti)
SIAM Journal on Applied Mathematics 2018.

(2) : "Spectral preconditioners for the efficient numerical solution of a continuous branched transport model"
(Luca Bergamaschi, Enrico Facca, Angeles Martinez Calomardo
and Mario Putti), Journal of Computational and Applied
Mathematics", 2018.

Research interests:
My research interests are mainly focused on the study, both from the theoretical and the numerical point of view, of a model described in (1), where it was conjectured the equivalence between the long-time
limit of the the dynamic equations of model and the solution of the Optimal Transport Problem (OTP), an expanding area of maths studies the least-cost strategies to reallocate ``resources". Although a complete proof of the conjecture is still missing, the numerical evidence shows that the numerical solution of the OTP via the proposed model is efficient and robust.

Languages:
Italian: Mother tongue
English: Understanding (B2) Speaking (B2) Writing (B2)
Spanish: Understanding (B2) Speaking (B2) Writing (B2)

Computer skills:
-Competent with most Microsoft Office programs
-Competent with Unix and Windows system
-Expert with Fortran 77, 90 and 2003
-Competent with Python 2.0

EMMA PERRACCHIONE

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Previous positions:
03/17-Pres: PostDoc, Department of Mathematics T. Levi-Civita, University of Padova, advisor Prof. S. De Marchi.

Education:
24/03/17 Ph.D. in Mathematics cum Laudae, University of Torino. Advisor Prof. A. De Rossi

Member of organizing committees
2018: workshop Seminari Padovani di Analisi Numerica, Padova, Italy, May 3—4, 2018.
2016: workshop Il nettare della matematica, Torino, Italy, October 7, 2016.
2016: miniworkshop Kernel-based methods and function approximation, Torino, Italy, February 5, 2016

Awards, prizes and grants:
2016: Funding Young Researchers for the project: Tecniche per l'approssimazione locale ottimale con metodi meshfree, sponsored by GNCS-INdAM.
2015: Award Silver Medal and Prize Luciana Picco Botta sponsored by the University of Torino for the best master thesis in the academic year 2012-2013.

Most relevant publications
[1] R. Cavoretto, A. De Rossi, E. Perracchione, Optimal selection of local approximants in RBF-PU interpolation using bivariate LOOCV, J. Sci. Comput. 74 (2018), pp. 1—22.
[2] A. De Rossi, E. Perracchione, Positive constrained approximation via RBF-based partition of unity method, J. Comput. Appl. Math. 319 (2017), pp. 338—351.
[3] R. Cavoretto, S. De Marchi, A. De Rossi, E. Perracchione, G. Santin, Partition of unity interpolation using stable kernel-based techniques, Appl. Numer. Math. 116 (2017), pp. 95--107.
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FEDERICO PIAZZON: Academic Curriculum
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Birth: May 24th 1981
Residence: via G. Puccini 11/B Albignasego (PD) 35020, Italy.
CURRENT POSITION
Post doctoral Research fellowship (24 months), University of Padova, under the supervision of Prof. Marco Vianello.
PREVIOUS POSITIONS
Research fellowship (18 months) post-lauream NEM Numerical methods for Environmental Modelling, University of Padova, under the supervision of Prof. Mario Putti.
EDUCATION
-2016 Ph.D degree, Department of Mathematics, University of Padova., Doctoral dissertation: Bernstein Markov Properties and Applications., Supervisor: Prof. Norm Levenberg (Indiana University, Bloomington IN, usa).
-2012 Master (Laurea Magistrale), University of Padova, Padova, thesis: Recent Results in the Theory of Polynomial Weakly Admissible Meshes. Supervisor: Prof. Marco Vianello, Counter-Supervisor: Prof Len Bos (University of Verona)
LANGUAGES
Italian mother tongue, English fluent

RESEARCH ACHIEVEMENTS
-I am author or co-author of 14 published journal papers (peer-review), 1 conference proceedings, and some
submitted papers currently under review. I am currently preparing some more articles containing the remaining parts of my doctoral dissertation and some results obtained during the fellowship NEM.
-I attended to several international conferences where I presented my results either by talks,poster-sessions or giving a mini-course (see the attached List of Scientific

OTHER ACHIEVEMENTS
-Organizer of the Dolomites Research Week on Approximation (DRWA2016,2017,2018 Alba di Canazei Italy)
-Editor of two special issues of Dolomites Reaserch Notes on Approximation (DRNA)
-Organizer of SPAN14 SPAN18 at University of Padova
-Reviewer for JAT, Costr. Approx, CMFT and DRNA

DAVIDE POGGIALI

PostDoc fellow in Numerical Analysis, PhD in Neurosciences in 2017 and Master's Degree Mathematics in 2012, keen on numerical and biomedical applications.
Fields: Neuroimaging, Mathematics, Programming.

Skills

Languages
Italian: Mother-tongue, English: Fluent, French: Good

Numerical Analysis: advanced numerical skills, in particular in error analysis, kernel methods, finite elements methods. Good knowledge of System Theory and regularization methods.

Applied mathematics: machine learning techniques (with scikit-learn) and statistical analysis (with R).

Neuroimaging: good experience of Freesurfer, FSL, ANTs, mipav, and Python packages for numerical imaging.

Programming: Matlab/Octave/Scilab,LaTeX, Python: Advanced
R, Julia, bash: Intermediate
C/C++, html/css: Beginner
Certificates: Certified Scilab Professional, ECDL

9 Pubblications between 2014 and 2018 in 9 different journals.

Relevant pubblications:

M. Puthenparampil, et al.
Trans-synaptic degeneration in the optic pathway. A study in CIS and early RRMS with or without optic neuritis
PLoS ONE, doi: 10.1371/journal.pone.0183957.

D. Cecchin, et al.
A new integrated dual time-point amyloid PET/MRI data analysis method
EJNMMI, doi: 10.1007/s00259-017-3750-0.

M. Puthenparampil, et al.
Cortical relapses in MS
Multiple Sclerosis Journal, doi: 10.1177/1352458514564483.

A. Favaretto, et al.
The Parallel Analysis of PSIR and DIR Images Significantly Improves the Detection of Cortical Lesions in MS since Clinical Onset
PLoS ONE, doi: 10.1371/journal.pone.0127805.

D. Cecchin, et al.
Analytical and experimental FWHM of a gamma camera: theoretical and practical issues
PeerJ, doi:10.7717/peerj.722.

2.3 Stato dell'Arte: base di partenza scientifica nazionale ed internazionale
State of the Art

This project aims to apply some techniques from multivariate approximation by polynomials and radial basis functions in a nonstandard way for two main important applications: medical images from Magnetic Resonance (MRI or MRI/PET or SPECT) and Magnetic Particle Imaging (MPI), as well as remote geospatial sensing and computational optics. Since 2005 the Constructive Approximation and Applications (CAA) Research Group (http://www.math.unipd.it/~marcov/CAA.html) is collaborating in the field of Constructive Approx. and Applications with a special interest in the study of effective approximation algorithms as well as in the production of reliable numerical software. The group is collaborating with many researchers worldwide (presently 26) and is also the principal supporting group of the Italian Network on Approximation https://sites.google.com/site/italianapproximationnetwork/

Among the research interests of the group we recall the following:

- Caratheodory-Tchakaloff Subsampling

- Mathematical Imaging in Medicine and Neurosciences

- Padua Points and Lissajous Sampling

- Stable Kernel-based Approximation and Applications

- SubPeriodic Harmonic Analysis

For the synopses and publications related to the various topics, we ask to refer to the web page of the CAA research. Here we simply emphasize that the group has developed many mathematical tools necessary for applications in life sciences, such as medicine, engineering, geosciences, optics, quantum physics, computational chemestry, statistics.

1. Concerning medical imaging applications, the CAA research group is collaborating with the Medical School of the University of Padova, in particular with the chair of Nuclear Medicine (who is now coordinated by prof. Bui in collaboration with prof. Cecchin) and the Department of Neurosciences (the PI affiliates to the Padova Neurosciences Center, too). This multidisciplinary collaboration has produced various interesting results (papers on scientific journals, conferences, reports, master's and Ph.D. theses) and some research positions (PhD, post-doc and temporary assistant professor position). The group is working since then and has already developed new tools for imaging and image-derived neurological data analysis, with focus on numerical methods and error estimation by kernel-based approximation. These methods have succesfully been applied in MRI, PET, SPECT imaging and in neuroclinical research, as well as in MPI by Lissajous sampling.

Relevant references
- D. Cecchin, D, Poggiali, L. Riccardi, P. Turco, F. Bui, S. De Marchi: "Analytical and experimental FWHM of a gamma camera: theoretical and practical issues, PeerJ 3:e722 (2015).
- De Marchi S., W. Erb and F. Marchetti: "Spectral filtering for the reduction of the Gibbs phenomenon of polynomial approximation methods on Lissajous curves with applications in MPI"
Dolomites Res. Notes Approx. 10 (2017), pp. 128--137.

2. Remote geospatial sensing involves imaging of the Earth from aircraft or spacecraft at scales ranging from a few square kilometers to the entire globe. Images are formed from visible light as well as near-infrared light, thermal radiation, and microwave radiation, and thus extend well beyond the range of the human eye. It is then interesting and necessary to dispose of tools for extracting information from these images (for example, mapping vegetation properties over large areas). This extraction should be fast and not expensive in terms of spatial memory. Therefore compression techniques should be applied. The Caratheodory-Tchakaloff compression method, is indeed the tool that we wish to apply in these applications.

Relevant references
- M. Vianello: "Compressed sampling inequalities by Tchakaloff's theorem", Math. Inequal. Appl. 19 (2016), 395--400.
- F. Piazzon, A. Sommariva and M. Vianello: "Caratheodory-Tchakaloff Subsampling", Dolomites Res. Notes Approx. 11 (2018).

2.4 Descrizione del Programma di Ricerca
Description of the research program

The proposed project aims to develop new mathematical methodologies, by means of nonstandard mathematical techniques, in medical imaging analysis in images acquired either by MRI/MPI or PET and in the life sciences fields known as remote geospatial sensing and optics. We present the proposed project subdividing it in two guidelines, L1 and L2, corresponding to the main areas of interest of our applications: medicine and geophysics in broad sense. Furthermore each guideline is subdivided in two sub-guidelines to better describe the applications we have in mind.

**Note: the references are indicated at the end of the program description, subdivided for L1 and L2.

L1. Approximation of medical images.

It is well-known that nowadays medical investigations are using more and more imaging analysis, computations and elaboration with images acquired by various equipments: X-rays are the basis for CT, magnetic fields are used in MRI,MRI-PET/SPECT or more recently in MPI techniques. In general, all images then require some post-processing in order to better understand and analyse the meaning of patches and colors that describe the internal parts of the human body (brain, organs etc) or evolution in time of features of the human body (tumors, fetus). We propose two methodologies, one based on kernel-based approximation combined with optimal transport for imaging comparison in MRI and a second one aimed to classify activity curves in PET imaging. One goal is to merge these two techniques in one application.

L1.1 Kernel-based approximation.

We have started to use kernel-based approximation in reconstructing CT-images since some years (cf. [DeM16, DeM18]), showing the effectiveness of this technique in approximating Radon data.
Kernel-based methods can be applied also in quantifying the morphological changes in Magnetic Resonance Imaging (MRI). Our aim
is the application of this approach in neuroimages analysis.
MRI images from a set of control subjects (that can be considered as not affected by any neurodegenerative disease) will be used for the creation of a spatiotemporal template [Gholipour17], with the age of every subject as the time. This template acts as a model of normal neurodegeneration through aging.
MRI images from a second set (composed by healthy or affected subjects) will be aligned and compared to the template model in order to quantify the atrophy through a punctual, voxel-by-voxel measure of dissimilarity. Such error measure can be assessed with commonly-used diffeomorphic methods [Avants08] as well as with innovative methods based on Monge-Kantorovich Optimal Transport Problem (OTP) [Ambrosio, Facca18-2, Gerber17]. Optimal Transport is an expanding area of mathematical theory that defines robust metric, called Wasserstein metric, to measure distances between probability distributions.
This metric, has been used to compare images, in particular 2d-3d scans of brain, with the aim of recognizing abnormality of brain structure and functions.
The application of this OT tool has been extremely successful in this field [mi2017optimal] but it requires an high computational cost for the computation of Wasserstrein distance, limiting the application to automatically quantification on big data sets.
A new and efficient numerical method for the L1-Wassertein distance has been proposed in [Facca2018-1].
The so-obtained measure of neuronal atrophy can be then used in clinical studies to evaluate the condition and the apparent age of each single patient.

L1.2 Classification of time activity curves in PET imaging.

Positron Emission Tomography (PET) is a medical imaging technique that measure metabolic activity of the different tissues in the human body. This medical procedure is used in the diagnosis of tumors since anomalous metabolic activity is associated to the presence of cancerous cells. The tissues under exam are discretized in voxels, each of them representing a small volume and for each of them PET data provide metabolic activity. Moreover, thanks to the dynamic nature of

the technique, it is also possible to associate at each voxel the metabolic activity at different time sample of the exam duration. In this way, we can have a time series representing the metabolic activity over time for each voxel. The study and the characterization of these curves is very interesting since we can use them to differentiate between voxels with anomalous and regular activity. This discriminating problem is particularly tough due its dimension: although the time series are made of a small number of samples (< 100), their number, corresponding to the voxels number, is around N=10^6.
Clustering techniques can be used in order to cluster together time series (and hence the associated voxels) with similar course. In general, patterns similarity can be expressed in terms of patterns proximity usually measured by a distance function defined on pairs of patterns. A clustering algorithm is necessarily characterized by a process of data abstraction, since a compact description of the data set is needed. A typical way to manage this aspect is to describe each cluster in terms of its centroid, that is one cluster prototype. Here we choose a partitional clustering method, the C-Means algorithm [MACQ67], where the number of clusters is fixed a priori and the best partition is obtained evaluating iteratively a cost function. In this case the data set X is composed by N (corresponding to the voxel number) time series (or patterns) partitioned in C clusters.
Since the cluster number C can be choose much smaller than the total voxel number we can automatically reduce the number of time series we want to classify. Once peculiar time series shape are identified and represented by centroids, we can try different mathematical approaches to classify them and hence automatically discriminate between brain regions with different metabolic behavior. A first idea consists in the classification using features (like norm, gradient, spectrum, time-to-peak and so on) that can be easily extracted from the centroid. A second approach involves a fitting step using pre-determined classes of curves (for example RBF or splines) and then a classification based on curve parameters. Either way, the classification can be carried out using supervised machine learning algorithms like Support Vector Machine, Neural Networks, and Decision trees [Kot06].

L2. Applications of Sparse Approximation by Caratheodory-Tchakaloff Quadrature Compression

A discrete version of Tchakaloff theorem [Piazzon17-1, Piazzon17-2] on the existence of positive algebraic cubature formulas, that can be proved by the well-known Caratheodory theorem on conical combinations of finite-dimensional vectors, entails that the information required for multivariate polynomial approximation can be suitably compressed. The framework here is approximating a discrete measure by another one, with the same polynomial moments up to a certain degree, and a (much) smaller support. Extracting such "Caratheodory-Tchakaloff points" from the support of discrete measures by Linear Programming or Quadratic Programming (NNLS) [Sommariva15], we obtain compression of Algebraic Quadrature, QMC integration, Least Squares approximation and Polynomial Meshes on multivariate compact sets and manifolds.

L2.1 An application of Caratheodory-Tchakaloff compression arises in the framework of remote geospatial sensing.
We can compute nearly optimal nested sensors configurations for global polynomial regression on spatial domains with a complex shape, such as geographical regions of the Earth (temperature field, atmospheric pressure field, geomagnetic field, ...). The goal is to compress thousands of low-discrepancy sampling points into a small subset of weighted points, keeping the size of the uniform regression error estimates with compression ratios of 1-2 orders of magnitude. Since the l1-norm of the weights remains constant by construction,
this technique differs substantially from the most popular compressed sensing methods based on l1-minimization (such as Basis Pursuit, that is also used in line L1.1 in the OTP approach to image approximation).

L2.2 Another application arises in computational adaptive optics, namely in the computation of RMSWE (Root Mean Square Wavefront Error) by ray tracing in optical systems where the entrance pupil has a complex shape. This is relevant for example in controlling obscuration and vignetting of the LSST (Large Synoptic Survey Telescope) camera by intersection/difference with several co-assial disks. We can construct algebraic quadrature formulas on such pupils by domain splitting and subperiodic trigonometric Gaussian quadrature on circular lunes, and then compress the resulting formula reducing substantially the number of sampling rays (see also [DaFies13, DaFies14]). This is a collaboration with Brian Bauman at the Optical Engineering team of the Lawrence Livermore National Laboratory (USA) [Bauman18].

**
As a final point, we would like to organize a web site of the NATIRESCO project, putting the relevant information and updates of results (papers, seminars, meetings, collaborations).

** References L1**

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http://cvgmt.sns.it/paper/1008/

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Symmetric diffeomorphic image registration with cross-correlation: Evaluating automated labeling of elderly and neurodegenerative brain,
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[DeM16] S. De Marchi, A. Iske, A. Sironi
Kernel-based Image Reconstruction from Scattered Radon Data
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special issue for the workshop "Kernel-based methods and function approximation".

[DeM18] S. De Marchi, A. Iske and G. Santin
Image Reconstruction from Scattered Radon Data with Weighted Positive Definite Kernel Functions,
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"Towards a Stationary Monge--Kantorovich Dynamics: The Physarum Polycephalum Experience", SIAM Journal on Applied Mathematics 78(2) (2018), pp 651-676.

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[Gholipour17] A. Gholipour, C. K. Rollins, C. Velasco-Annis, A. Ouaalam,A. Akhondi-Asl, O. Afacan, C. M. Ortinau, S. Clancy, C. Limperopoulos, E. Yang, J. A. Estroff, and S. K. Warfield,
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[MACQ67] J. B. MacQueen: “Some methods for classification and analysis of multivariate observations”,
Proceedings of 5-th Berkeley Symposium on Mathematical Statistics and Probability. University of California Press, 1: 281-297, 1967.

** References L2 **

[Bauman18] B. Bauman, A. Sommariva and M. Vianello,
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to the LSST camera, in preparation.

[Piazzon17-1] F. Piazzon, A. Sommariva and M. Vianello,
Caratheodory-Tchakaloff Least Squares, Sampling Theory and Applications 2017, IEEE Xplore Digital Library, DOI: 10.1109/SAMPTA.2017.8024337.

[Piazzon17-2] F. Piazzon, A. Sommariva and M. Vianello,
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Dolomites Res. Notes Approx. DRNA 10 (2017), 5--14.

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Algebraic cubature by linear blending of elliptical arcs,
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2.5 Obiettivo del Programma di Ricerca e, nel caso di assegni di ricerca, indicazione dei risultati attesi dall'attività dell'assegnista/assegnisti previsti alla fine del primo anno e a conclusione della ricerca
Short-term and long-term goals and expected results

As outlined in the program description, the project aims to develop new methodologies, by means of nonstandard mathematical techniques, in medical imaging analysis, in remote geospatial sensing and optics.

There are essentially three objectives that we wish to pursue.

1. Consolidate the collaboration of the CAA Research Group, the Neuroimaging section of the Department of Medicine and the Padova Neurosciences Center of the University with other important institutions worldwide. This collaboration will deal with the study of new mathematical tools in image analysis, by taking into account also the new technologies and machines available at the hospital. In particular we would like to use our expertise on kernel-based approximation in quantifying the morphological changes in Magnetic Resonance Imaging (MRI). Images are essentially those from MRI and PET/MRI. There is also another way to get a scan of human body (or part of it), by the MPI scanners. The study of Lissajous curves and Lissajous nodes, can give quantitative and qualitative information on MPI images. We wish to learn more on Lissajous sampling also for image filtering and detection of image discontinuities. For this purpose we have already started a new approach based on Rational RBFs. Therefore it would be another objective of the project to make a bridge between these approaches and learning from each other.

2. Optimal Transport is an expanding area of mathematical analysis that defines robust metric (Wasserstein), to measure distances between probability distributions. This metric, has been used to compare images, in particular 2d-3d scans of the brain, with the aim of recognizing abnormality of brain structure and functions.
A new efficient numerical method for the L1-Wassertein distance has been proposed in [Facca2018-1]. This measure we think to be useful to quantify neuronal atrophy and then be used in clinical studies to evaluate the condition and the apparent age of patients. Therefore another aim of the project is to apply this novelty to image evolution. A typical instance is the MRI of a fetus.
About this point, we would like to establish a research collaboration with the CNRS Bordeaux, Dr. Nicolas Papadakis, who uses OT on imaging since years and recently has organized a minysimposium on "Optimal Transport and Patch based Methods for Color Image Editing" at the SIAM-IS18 conference in Bologna (5-8 June, 2018).

3. Some members of the research team, are also involved in the "Horizon 2020 ERA-PLANET European project: GEOEssential (Essential Variables workflows for resource efficiency and environmental management)". GEOEssential will create a Knowledge Base infrastructure to facilitate the collection and formalization of the knowledge (i.e. user needs, gaps recognition and recommendations for closing gaps, best practices, Community of Practice lexicon, etc.) stemming from the European Network of Earth Observation Networks (http://www.eneon.net/graph) and from other significant Earth Observations (EO) initiatives and programs at the National and European levels. The Knowledge Base infrastructure will facilitate and advance the generation of new knowledge through EVs and also foster data integration and harmonization efforts. The use of image compression obtained by our guideline L2 (i.e. by using the discrete version of the Caratheodory-Tchakaloff theorem for cubature) has shown to be effective. We need to develop a faster implementation that allows to work with big images and make the extraction of the Tchakaloff points in an efficient way. The technique should also be interfaced with other compression tools, such as machine learning techniques. Moreover we have already established a collaboration with Dr. Brian J. Bauman at the Optical Engineering team of the Lawrence Livermore National Laboratory (USA) for the adaptive optics application of the cubature based on Caratheodory-Tchakaloff. We are also planning to *patent* such a technique. Prof. Vianello, who is in sabbatical leave next academic year (Oct. 2018-Sept. 2019), during his leave will work on this interesting idea of constructing efficient cubature rules on pupils.

2.6 Elementi e modalità per la valutazione dei risultati finali
Criteria for final evaluation

To evaluate the final results we plan to use these metrics

- achievement of initial goals;
- number of publications in international journals and/or conference proceedings;
- presentations at conferences and invited seminars;
- accesses to the websites of the researchers or any other websites (CAA, RITA) for downloading papers or looking for information;
- international collaborations created, intensified or born during the project;
- funds received for other projects started as consequence of this.

2.7 Informazioni aggiuntive
More informations

<br clear = all>

3.0 Costo del Programma
Program Cost

3.1 Assegni di ricerca da attivare in questo Programma di Ricerca
Research Grants

nº	Attività specifica nel progetto e competenze	Durata complessiva (mesi)	Costo complessivo assegno [1] (euro)	Quota cofin disponibile [2] (max 50%)	Tipologia dei fondi utilizzati a cofin [3]	Quota cofin chiesta al dipartimento
	TOTALE		**0.000**	**0.000**		**0.000**

3.2 Richiesta di attrezzature di importo superiore a 5.000 Euro
Equipments (> Eur 5.000)

nº	Descrizione attrezzatura da acquistare	Costo previsto (euro)
	TOTALE	**0.000**

3.3 Eventuale cofinanziamento del progetto

nº		Tipologia dei fondi utilizzati a cofin	Quota cofin disponibile
	TOTALE		**0.000**

3.4 Costo complessivo del Programma di Ricerca
Overall budget and breakdown of costs

	Descrizione	Costo complessivo assegno [1] (euro)
Materiale inventariabile/Durables		0
Materiale di consumo e funzionamento/ Consumables/Running costs		0
Congressi e missioni/ Conferences and University business trips	We have considered that the participants from the university (professors) will use the required amount for attending a couple of conferences per year or inviting the participants from aborad. Assuming about 5K euros per person, this gives 20K euros. The remaining 5K euros are for the other participants, post-docs and the PhD	25.000
Servizi esterni/External services		0
Assegni di ricerca/Research Grants	(vedi punto 3.1)	
Attrezzature scientifiche di importo superiore a 5.000 Euro / Equipments (> EUR 5000)	(vedi punto 3.2)	
TOTALE		**25.000**

Dichiarazione / Declaration

Il presente progetto NON prevede sperimentazione animale

Ai sensi decreto legislativo 196/03 sulla "Tutela dei dati personali" i dati contenuti nella domanda di finanziamento sono trattati esclusivamente per lo svolgimento delle funzioni istituzionali dell'Ateneo.
Incaricato del trattamento dei dati è il Cineca.

Il Responsabile della Ricerca: .....

Padova lì, 11/05/2018 14:37