
BIOGRAPHICAL SKETCH

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NAME: Edward John Ciaccio

eRA COMMONS USER NAME (credential, e.g., agency login): CIACCIOE

POSITION TITLE: Senior Research Scientist, Columbia University
Honorary Principal Research Fellow, Imperial College London

EDUCATION/TRAINING (*Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.*)

INSTITUTION AND LOCATION	DEGREE	Completion Date	FIELD OF STUDY
Rutgers University – New Brunswick	MS	10/1989	Biomedical Engineering
Rutgers University – New Brunswick	PhD	10/1993	Biomedical Engineering

A. Personal Statement

We have developed whole-heart models of myocardial electrical activation for analysis of ventricular tachycardia (VT), macroreentrant atrial tachycardia (AT), and atrial fibrillation (AF). The mechanisms involved in onset and perpetuation of these arrhythmias are incompletely understood. Our models provide insight which can lead to better treatment. We have shown how VT can be precipitated by functional conduction block forming at lateral boundaries of the isthmus, around which abnormal electrical circuits reenter previously excited tissue to initiate and maintain VT. We have used mathematics to show that the main cause of block can be source-sink mismatch in the electrical conduction process, present as the wavefront propagates from a thinnest surviving layer after myocardial infarction (MI), to a much thicker border zone laterally away from the region. We have also shown by mathematical modeling that the signals acquired from this region can be fragmented at and near the lateral isthmus boundaries, and that electrogram instability is a marker to indicate the arrhythmogenic region during therapy. Recent studies in clinical EPS with newly developed high-resolution imaging methods suggest our models are indicative of the arrhythmogenic process. We have recently found similar properties of uniform low voltage and uniform slow conduction at AT bottlenecks where onset occurs, possibly indicating similarly thinned viable substrate and similar mechanisms. We have used automaton modeling to show that dispersion of refractoriness and presence of fibrosis of sufficient density both lead to formation of rotational electrical activity which drives fibrillatory wavefronts in AF. We have suggested that reentrant circuits driving AF may have similar origins, mechanisms, and properties as those forming during VT and AT. In celiac disease research, we have shown that inflammatory load may be important for onset and continuation of symptoms. I am founding editor of Informatics in Medicine Unlocked journal, Elsevier (2015-2023), and edited Computers in Biology and Medicine (2013-2021). Both went from Q4 to Q1. CBM submissions increased from 500 in 2013 to 7,500 in 2021, one of the highest journal submission rates in the field.

Four impactful cardiology publications of relevance—

- a. Ciaccio EJ, Wolf RL, Ciacci C, Green PH, Acharya UR. Celiac disease onset and the inflammatory milieu. World Journal of Gastrointestinal Endoscopy (in press) 2026.

- b. Ciaccio EJ, Hsia HH, Saluja DS, Garan H, Coromilas J, Yarmohammadi H, Biviano AB, Peters NS. Ventricular tachycardia substrate mapping: What's been done and what needs to be done. *Heart Rhythm*. 2025 Sep;22(9):2280-2299. PMID: 39988104.
- c. Ciaccio EJ, Anter E, Coromilas J, Wan EY, Yarmohammadi H, Wit AL, Peters NS, Garan H. Structure and function of the ventricular tachycardia isthmus. *Heart Rhythm*. 2022;19:137-153. PMID: 34371192.
- d. Ciaccio EJ, Ashikaga H, Kaba RA, Cervantes D, Hopenfeld B, Wit AL, Peters NS, McVeigh ER, Garan H, Coromilas J. Model of reentrant ventricular tachycardia based on infarct border zone geometry predicts reentrant circuit features as determined by activation mapping. *Heart Rhythm*. 2007 Aug;4(8):1034-45 PMID: 17675078.

B. Positions, Scientific Appointments, and Honors

Positions and Employment:

01/2016 - present	Department of Medicine, Imperial College <i>Honorary Principal Research Fellow</i>	London, England
02/2014 - present	Department of Medicine, Columbia University <i>Senior Research Scientist</i>	New York, NY
07/2005 – 02/2014	Department of Medicine, Columbia University <i>Research Scientist</i>	New York, NY
09/1996 - 05/2006	Dept. of Biomedical Engineering, City College of NY <i>Grant Professor of Biomedical Engineering (Adjunct)</i>	New York, NY
09/1996 - 05/2006	Dept. of Biomedical Engineering, Columbia University <i>Assistant Professor of Biomedical Engineering (Adjunct)</i>	New York, NY
07/1994 - 06/2005	Department of Pharmacology, Columbia University <i>Associate Research Scientist</i>	New York, NY
07/1990 - 06/1994	Department of Pharmacology, Columbia University <i>Staff Associate</i>	New York, NY

Honors:

2024	Top Scholar, Scholar GPS
2013-2018	Highly Performing Peer Reviewer, World Journal of Gastroenterology
2012-2018	Highly Performing Peer Reviewer, World Journal of Gastrointestinal Endoscopy
2010-2015	BioMedical Engineering OnLine, 'Highly Accessed'
2009-2017	Remarkable Reviewer, Heart Rhythm Journal
2010	Poster of Distinction, Digestive Disease Week, Amer Gastr Assoc
2008	Basic Science Paper of the Year (1 of 4) Heart Rhythm J, Ann Meet. 2008
1999-2002	Established Investigator of the American Heart Association
1996	1st Place (tie), ISE Young Inv. Award, 23rd Int Cong Electrocard Cleveland OH
1995	Final Four, ISCE Young Inv. Award, 20th Comp Electrocard, Amelia Island, FL
1994	2nd Place (postdoctoral, sig proc) 13th IEEE Southern Bioeng Conf, Wash, D.C.
1992	1st Place (graduate student paper, sig proc) 18th IEEE NE Bioeng, Kingston, RI

Editorial:

Editor-in-Chief

06/2015-12/2023	Informatics in Medicine - Unlocked (Elsevier, Founding Editor) (Q1 journal, IF~8)
01/2013-12/2021	Computers in Biology and Medicine (Elsevier) (Q1 journal, IF~8)

Editorial Board Member:

2017-present Annals of Translational Medicine
2012-present World Journal of Gastrointestinal Endoscopy
2011-2020 World Journal of Gastroenterology
2010-2018 Journal of Cardiovascular Electrophysiology
2008-2018 Heart Rhythm Journal
2000-present BioMedical Engineering OnLine

Invited Lectureships:

2023 Faculty Speaker, Consensus Meeting - Atrial Fibrillation Drivers, Reykjavík, Iceland
2023 Faculty Speaker, Celiac Disease International Symposium, New York
2022 Faculty Speaker, 17th Annual Symposium - Ventricular Arrhythmias, New York
2022 Keynote Speaker, Digital Futures and Technologies, Pakistan
2021 Faculty Speaker, Together VT, Bordeaux, France
2020 Faculty Speaker, 5th Annual Signal Summit in Electrophysiology, Boston
2018 Faculty Speaker, 3rd Annual Signal Summit in Electrophysiology, Boston
2017 Faculty Speaker, European Cardiac Arrhythmia Society 2017, Rome, Italy
2016 Grand Rounds, Medicine – Cardiology, University of Chicago
2015 Faculty Speaker, Atrial Signals and Atrial Fibrillation 2015, Karlsruhe, Germany
2015 Keynote Speaker, 4th Int Conference Bioengineering and Biotechnology, Wuhan, China
2014 Keynote Speaker, 3rd Int Conference Bioengineering and Biotechnology, Wuhan, China
2014 Keynote Speaker, Innovation in Medicine and Healthcare 2014, San Sebastian, Spain
2013 Keynote Speaker, 2nd Int Conference Bioengineering and Biotechnology, Wuhan, China
2006 Faculty Speaker, 1st Annual Symposium - Ventricular Arrhythmias, Boston
1998 Faculty Speaker, Congress on Catheter Ablation, Nice, France
1995 Special Lecturer, Department of Biomechanics, Boston University, Boston, MA
1994 Course Director, 17th Annual IEEE Great Lakes Bioengineering Conf, Milwaukee WI.
1994 Moderator, Special Symposium on New Analytic Techniques for Bioengineering, IEEE Annual Meeting, Washington, DC.

Grant Peer Review:

2026, 2024, 2023 United Arab Emirates University
2024 American Heart Association, Cardiology Grant Peer Review
2023 and 2024 National Institute of Standards and Technology, BIRD Foundation
2024 Sir Jules Thorn Charitable Trust, UK
2013 Austrian Science Fund
2009 Estonian Science Foundation - ETF
2007 Research Council for Natural Sciences and Engineering of the Academy of Finland
2002 US Veterans Administration
1995 NIH - Special Study Section (R01)

C. Contributions to Science

1. Onset and perpetuation of ventricular tachycardia

To the present time, the onset and perpetuation of ventricular tachycardia (VT) caused by a reentrant circuit is mysterious. We have developed a source-sink (impedance) mismatch mathematical model of reentrant VT based on canine postinfarction studies. It describes reentrant circuits as forming

at an area with small tissue volume, i.e., the thinnest infarct border zone. We have shown how this can occur in two and three dimensions. It was then elucidated how functional conduction block would form at lateral margins or boundaries, where there is a sharp transition to greater volume (thicker tissue). At more gradual border zone thickness transition at reentry isthmus entrance and exit, functional block can occur, but only at the very short coupling intervals of premature stimulation, causing unidirectional block and resulting in VT onset. Several clinical studies suggest similar results.

- a. Ciaccio EJ, Cedilnik N, Hsia HH, Biviano AB, Garan H, Yarmohammadi H. Wavefront Curvature Analysis Derived from Pre-Procedural Imaging Can Identify the Critical Isthmus in Patients with Post-Infarcted Ventricular Tachycardia. *Heart Rhythm*. 2024 Jun 5:S1547-5271(24)02669-9. PMID: 38848858
- b. Ciaccio EJ, Saluja DS, Peters NS, Yarmohammadi H. Role of activation signatures in re-entrant ventricular tachycardia circuits. *J Cardiovasc Electrophysiol*. 2024 Feb;35(2):267-277. 38073065
- c. Ciaccio EJ, Coromilas J, Wit AL, Peters NS, Garan H. Source-sink mismatch causing functional conduction block in re-entrant ventricular tachycardia. *JACC: Clinical Electrophys* 2018;4;1-16. PMCID: PMC5874259, PMID: 29600773.
- d. Ciaccio EJ, Coromilas J, Wit AL, Peters NS, Garan H. Formation of Functional Conduction Block During the Onset of Reentrant Ventricular Tachycardia. *Circ Arrhythm Electrophysiol*. 2016 Dec;9(12):e004462. PMID: 27879278.

2. Sinus rhythm properties when ventricular tachycardia is inducible in postinfarction hearts

For substrate modification during EP study, it would be very useful to describe and detect helpful and salient properties of sinus rhythm electrograms and activation maps which are harbingers of reentrant VT circuits. However till recently, many such proposals have failed. We have proposed since 2001, with recent elaboration, the possibility that sinus rhythm electrograms and activation maps are important and reflect the underlying border zone leading to reentrant VT. Specifically, we have suggested and mathematically modeled how fractionated electrograms can occur during sinus rhythm at lateral reentry isthmus boundary locations, and how slow uniform sinus rhythm activation would be expected at the location where the reentry isthmus forms. Recent clinical work has validated our findings, and this information is now beginning to be utilized in clinical practice.

- a. Ciaccio EJ, Coromilas J, Hsia HH, Wan EY, Yarmohammadi H, Saluja DS, Biviano AB, Peters NS. Narrowed sinus rhythm electrograms in the zone of uniform slow conduction are helpful to identify VT isthmus location, shape, and orientation. *Heart Rhythm*. 2025 Nov;22(11):2961-2970. PMID: 40578654.
- b. Ciaccio EJ, Hsia HH, Robinson D, Cedilnik N, Zeldin L, Wan EY, Biviano AB, Yarmohammadi H, Saluja DS. Uniform slow conduction during sinus rhythm and low voltage/low voltage gradient $\Delta V/V$ characterize the VT isthmus location. *Heart Rhythm*. 2025 Oct;22(10):2486-2496. PMID: 39615817.
- c. Ciaccio EJ, Coromilas J, Saluja DS, Hsia HH, Peters NS, Yarmohammadi H. Sinus rhythm activation signature indicates reentrant ventricular tachycardia inducibility and approximate isthmus location. *Heart Rhythm*. 2024 Apr 25:S1547-5271(24)02517-7. PMID: 38677360
- d. Ciaccio EJ, Coromilas J, Wan EY, Yarmohammadi H, Saluja DS, Peters NS, Garan H, Biviano AB. Lateral boundaries of the ventricular tachycardia circuit align with sinus rhythm discontinuities. *JACC Clin Electrophysiol*. 2023 Jun;9(6):851-861. PMID: 37227361

3. *Agitators and instigators of atrial arrhythmia*

Atrial arrhythmias are common, yet their mechanisms of onset and perpetuation are not entirely understood. We have shown that macroreentrant atrial tachycardia bottlenecks have properties of uniform low voltage and uniform slow conduction, like the isthmus of reentrant ventricular tachycardia. The detected bottlenecks were sometimes overlapping with operator determined ablation target locations, but included other areas as well. Regarding atrial fibrillation, an automaton model was developed to show how various factors, including alterations in refractory period and action potential duration, and altered areas of conduction block, can cause reentrant activity that may lead to onset.

- a. Ciaccio EJ, Hsia HH, Coromilas J, Talke M, Majumder JA, Schwartz SM, Lavelle Jr MP, Garan H, Yarmohammadi H, Wan EY, Peters NS, Biviano AB, Saluja D. Activation signature valleys are predictive of macroreentrant atrial tachycardia bottlenecks where uniform low voltage and uniform slow conduction reside. *Heart Rhythm* (in press) 2026.
- b. Ciaccio EJ, Hsia HH, Yarmohammadi H, Wan EY, Peters NS, Saluja D, Biviano AB. Atrial fibrillation substrate mapping with emphasis on voltage-based guidance. *World J Cardiol*. 2025 Nov 26;17(11):109739. PMID: 41356592; PMCID: PMC12678882.
- c. Ciaccio EJ, Peters NS, Garan H. Use of an automaton model to suggest methods for cessation of intractable fibrillatory activity. *Comput Biol Med*. 2018;102:357-368. PMID: 30097173.
- d. Ciaccio EJ, Peters NS, Garan H. Effects of refractory gradients and ablation on fibrillatory activity. *Comput Biol Med*. 2018;95:175-187. PMID: 29501736.

4. *Mathematical transforms and algorithms*

Our spectral estimation method, like the Fourier transform, utilizes the autocorrelation function for spectral analysis, but does so in a highly efficient way which can be useful for real-time implementation. The spectral analyzer has also been found helpful to confirm the results of Fourier analysis in several clinical studies. Our LMS algorithm is implementable with a few lines of computer code, and it enables fast adaptive filtering and noise cancellation of signals, which is useful for electrocardiogram analysis. The filter weights can be used for adaptive template matching and for sampling information about signal scale and shift, with magnitudes provided by the parameters.

- a. Ciaccio EJ, Tennyson CA, Bhagat G, Lewis SK, Green PH. Use of basis images for detection and classification of celiac disease. *Bio-Medical Materials and Engineering* 2014;24:1913-1923. PMID: 25226887.
- b. Ciaccio EJ, Biviano AB, Garan H. Software algorithm and hardware design for real-time implementation of new spectral estimator. *BioMed Eng OnLine* 2014;13:61. PMID: 24886214.
- c. Ciaccio EJ, Biviano AB, Whang W, Coromilas J, Garan H. A new transform for the analysis of complex fractionated atrial electrograms. *BioMed Eng OnLine* 2011;10:35-45. PMID: 21569421.
- d. Ciaccio EJ, Biviano AB, Whang W, Garan H. A new LMS algorithm for analysis of atrial fibrillation signals. *BioMed Eng OnLine* 2012;11:15. PMID: 22449196, PMCID: PMC3442996.

Complete List of Published Work in Bibliography:

<http://www.ncbi.nlm.nih.gov/pubmed/?term=ciaccio+ej+%5Bau%5D>