

My doctoral dissertations were based on multiple disciplines including mathematics, physics and computational biology. The title of my 1st thesis “On the cross curvature tensor and the cross curvature flow” (Differential Geometric Equations) is based on the realization of a given prescribed cross curvature tensor introduced by Richard Hamilton on a compact 3-manifold and it will support further analysis of Hamilton’s conjecture that, after normalization, for initial metrics on closed 3-manifolds with negative sectional curvature, the solution of the cross curvature flow (an evolution equation of metrics on 3-manifolds) exists for all time and converges to a hyperbolic metric. This conjecture is still open at the present time. The title of my 2nd thesis, “Mathematical Modeling of Oxygen Transport, Cell Killing and Cell Decision Making in Photodynamic Therapy of Cancer” (Systems Biology), is based on the examination of the effects of oxygen diffusion and transport on the observed kinetics during Photodynamic Therapy of cancer. This research provides the logical design and computational algorithm for the decision-making process of a single cell and can be adjusted to accommodate and provide important insights for other cellular responses to other treatments.

My research addresses two broad topics: mathematical and experimental medicine and biology; and geometric analysis and theoretical physics. At present, my research is focused in three areas: (a) Connectome analysis, topological features of brain networks, emergence in dynamic complex systems such as the human brain (mathematical neuroscience), (b) biomolecular network modeling, design and use of various cancer treatment modalities, (c) connections between gravity, information and geometric evolution equations. I am co-inventor of two health related treatments. One of them was approved for laboratory experiments on human subjects by the Brazilian Research Ethics Committee. Cancer Hospital, Pernambuco, Brazil, 2015.

I have taught over 45 undergraduate classes during the last 5 years. My professional experience as an instructor has helped me develop the ability, to enhance and direct undergraduate programs, including designing new courses, advising majors, and interacting with faculty from various science departments. I have provided comprehensive instruction in mathematics, physics and astronomy and have taught different courses across the undergraduate curriculum. Because of my research interests’ focus, a broad range of methods and models can be readily tailored for undergraduate and graduate research and provide students with research opportunities for various projects. I have been an active member of several committees and institutes that foster the advancement of research and education in science, such as the American Institute of Biological Sciences (AIBS) and the Institute of Electrical and Electronics Engineers (IEEE). I have more than 30 peer reviewed articles published and I am the author of one book. I serve as editor for five journals and have peer reviewed a number of research articles. I have also mentored students at all levels.