PROMOTION RECOMMENDATION
THE UNIVERSITY OF MICHIGAN
MEDICAL SCHOOL
DEPARTMENT OF COMPUTATIONAL MEDICINE AND BIOINFORMATICS
COLLEGE OF LITERATURE, SCIENCE, AND THE ARTS
DEPARTMENT OF MATHEMATICS

Indika Rajapakse, Ph.D., associate professor of computational medicine and bioinformatics, with tenure, Department of Computational Medicine and Bioinformatics, Medical School, and associate professor of mathematics, without tenure, Department of Mathematics, College of Literature, Science, and the Arts, is recommended for promotion to professor of computational medicine and bioinformatics, with tenure, Department of Computational Medicine and Bioinformatics, Medical School, and professor of mathematics, without tenure, Department of Mathematics, College of Literature, Science, and the Arts.

Academic Degrees:
Ph.D.   2004   Washington State University, Pullman, WA
B.Sc.   1997   University of Moratuwa, Moratuwa, Sri Lanka

Professional Record:
2018 - present   Associate Professor (with tenure), Computational Medicine and Bioinformatics, University of Michigan
2018 - present   Associate Professor, (without tenure), Department of Mathematics, University of Michigan
2014 – 2018   Assistant Professor, Department of Mathematics, University of Michigan
2013 – 2018   Assistant Professor, Computational Medicine and Bioinformatics, University of Michigan

Summary of Evaluation:
Teaching: Dr. Rajapakse is an excellent educator, both inside and outside the classroom. Dr. Rajapakse has been highly active in teaching courses in DCMB and Mathematics. He conceived and designed Mathematics of Biological Networks (BIOINF 540/MATH 540), where graduate students explore methods and principles for constructing and studying, and studying the structure and function of biological networks using examples from real datasets. The course began with eight students and grew significantly to 75 graduate students in the fall of 2021 with students from engineering, mathematics, bioinformatics, and cell biology. As of fall 2022, the course was enrolled at a maximum capacity of 100 with waitlisted students. He has also designed and taught Mathematics of Data (BIOINF 547/Math 547), for graduate students and upper-level undergraduate students. He teaches BIOINF 520 where he has introduced mathematical and computational modeling for both experimentally and theoretically inclined students, as well as the currently employed strategies to investigate physiological problems with computational modeling. He has also served as the course master for BIOINF 602/603 Bioinformatics Journal Club. His evaluations are overall very positive (85%), with many stating that he is their "most inspiring teacher" and "his energy is infectious."

Dr. Rajapakse has mentored undergraduate students, graduate students, post-doctoral research fellows, and visiting scholars. In addition, he is frequently requested to be a member of dissertation committees, and was the chair or co-chair for several of them. Several of his Ph.D. graduates have all gone on to

exciting new careers in industry and academia. He has also been requested and served as a member of numerous preliminary examination committees.

As a testament to his teaching prowess, he received the 2016 Basic Science Teaching Award. In 2016, he was also nominated for the Golden Apple Award, which honors teachers who consistently teach as if each lecture were their last and inspire students.

Research: A key overarching research theme underlying Dr. Rajapakse's work is the quest to develop methods for controlling complex biological systems. The notion is to assess whether and how a dynamic system might be controllable and to predict which external input would be required to steer a dynamic network to the desired state. He can apply his methods to a rich set of biological systems and biomedical models. His series of seminal papers, co-authored with Professor Steven Smale, a Fields Medalist (Math Nobel equivalent), and his other biomathematics papers, are widely recognized as important new contributions to this field.

Dr. Rajapakse has expanded upon the pioneering work by Harold Weintraub in 1989 who showed that skin cells could be reprogrammed into muscle cells using a single transcription factor, MyoD, rather than cells having fixed, inflexible identities, furthering the concept of flexible cell identity. He also bases his work on the advances made by 2011 Nobel Prize winner Shinya Yamanaka's work in 2007 showing that human skin cells could be reprogrammed into embryonic-stem-cell-like cells using four transcription factors. These findings demonstrated the potential of reprogramming technology. He developed a framework, based on data and mathematics ("data-guided control"), for directly reprogramming skin cells into any other cell type.

Dr. Rajapakse is a recognized international expert in the development and application of mathematical and computational methods to measure and analyze chromatin conformation in the cellular nucleus. Recently, Dr. Rajapakse built on his chromosome conformation capture (Hi-C) research and technology platform developments to establish a higher-order extension of Hi-C ("Pore C") leveraging the long reads of the Oxford Nanopore Sequencing. While Hi-C provides pair-wise contacts across the genome, Pore-C identifies contacts among multiple loci. His work on Pore-C was integrated with his mathematical work on hypergraphs as a basis for a recent patent application. He has helped other labs implement Hi-C in their work, and plans to help interested labs implement Pore-C.

Dr. Rajapakse has published 54 peer-reviewed articles in leading journals such as *Nature Communications*, *IEEE Transactions on Network Science and Engineering*, *JCI Insight*, and *Methods*. He has served on national and international study sections including the National Science Center in Poland. His grant funding is robust and continuous. He is currently the principal investigator on six grants, with funding from the Department of Defense, the National Science Foundation, and foundation grants. Dr. Rajapakse is responsible for establishing a unique, independent research program that has garnered international recognition in the field.

Recent and Significant Publications

Dotson GA, Chen C, Lindsly S, Cicalo A, Dilworth S, Ryan C, Jeyarajan S, Meixner W, Stansbury C, Pickard J, Beckloff N, Surana A, Wicha M, Muir L, Rajapakse I, "Deciphering multi-way interactions in the human genome," *Nature Communications*, 2022 Sep 20;13(1):1-5. DOI:10.1038/s41467-022-32980-z

Lindsly S, Jia W, Chen H, Liu S, Ronquist S, Chen C, Wen X, Stansbury C, Dotson G, Ryan C, Rehemtulla A, Omenn G, Wicha M, Li S, Muir L, Rajapakse I, "Functional Organization of the Maternal and Paternal Human 4D Nucleome," *iScience*, 24(12):103452 (2021).

Sweeney P, Chen C, Rajapakse I, Cone R, "Network Dynamics of Hypothalamic Feeding Neurons," *Proceedings of the National Academy of Sciences*, 118(14):e2011140118 (2021).

Chen C, Surana A, Bloch A, Rajapakse I, "Multilinear Control Systems Theory," *SIAM Journal on Control and Optimization*, 59.1: 749-776 (2021).

Chen C, Rajapakse I, "Tensor Entropy for Uniform Hypergraphs," *IEEE Transactions on Network Science and Engineering*, 7(4):2889-2900 (2020).

Service: Dr. Rajapakse has actively been engaged within his professional community institutionally, and with broader state, regional, and international organizations. Institutionally, he serves as an organizer for the DCMB special departmental seminars. Nationally, he serves as an organizer for the AFRL/AFOSR Chief Scientist Distinguished Lecture Series. He has been instrumental in developing the Smale Institute of Mathematics and Computation, an open and global research institute to bring together multiple sciences using data and algorithms. He has partnered with Dr. Leland Hartwell (Nobel Prize, 2001) to develop and provide an engaging program to middle school students titled "Science of Me." He also published a series of interviews, titled "Interviews Across Disciplines" with two influential scholars, aimed at sharing how they think about problems in science. Internationally, he is an organizer of the Gene Dynamics and Chromosomes Workshop for City University in Hong Kong, and an organizer for Foundations of Computational Mathematics in Barcelona. Dr. Rajapakse is a reviewer for six journals: *Proceedings of the National Academy of Sciences, Nucleus*, *Bioinformatics*, *Journal of Mathematical Biology*, *PLOS Computational Biology*, *and Methods*. Dr. Rajapakse also serves as a Member of the Biointerfaces Institute and the Rogel Cancer Center at the University of Michigan.

External Reviewers:

Reviewer A: "Bringing a mathematical perspective into the study of human genomics, which is apparent in much of Indika's work, is a major contribution to the field… Indika's service to the profession is manifold. He has given invited presentations and organized numerous workshops and special sessions internationally, nationally, regionally and in Michigan, including the Smale Institute. He has served on boards, been an invited speaker, nationally and internationally, and at Michigan has been awarded numerous grants to support his group's research."

Reviewer B: "…I have read numerous works by Dr. Rajapakse on the mathematical theories of systems, control and networks. I find his work to always be creative, meaningful, and rigorous. I also find his problem choice to be always valuable and exciting… I find these three works to be of the highest quality. Dr Rajapakse is a leader in the emerging area of multi-agent systems defined over hypergraphs."
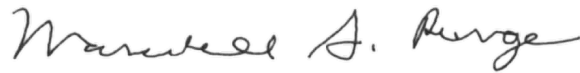
Reviewer C: "…Indika has proceeded to continually impress the community with his breadth of knowledge, passion for mathematical methods and expertise, enthusiasm for biological modeling and data analytics, and willingness to share and collaborate broadly in the community. He is certainly a high-level talent that is playing a foundational role in developing, growing and/or sustaining excellence in the biological/medical mathematical sciences community. He is, in my opinion, one of the strongest [junior] researchers in the medical mathematical sciences."

Reviewer D: "Dr. Rajapakse is an outstanding educator. He has developed and regularly teaches two courses, Mathematics of Biological Networks and Mathematics of Data. These courses are extremely well received with recent enrollments of 92 and 71 graduate students respectively. Both of these courses are highly innovative and should serve as templates for teaching computational biomedicine nationwide."
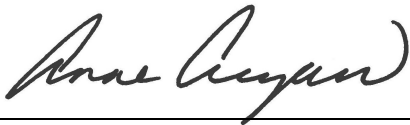
Reviewer E: "Dr. Rajapakse has a superb funding record with active grants from AFOSR and NIH, and several submitted. His teaching is also excellent both at the undergraduate and graduate levels where he has built a first-class research group. He is very active in several professional organizations such as SIAM and AMS, organizing workshops and lectures. I have heard him give lectures at several forums. Indika has the knack for making sometimes very technical mathematical concepts accessible to a wide audience of researchers with diverse backgrounds."

Summary of Evaluation:
Dr. Rajapakse has shown excellence and productivity in his research, scholarship, teaching, and service and has established himself as a national and international leader, especially in the methodological and biomathematical modeling and analysis aspects. We are pleased to recommend Indika Rajapakse, Ph.D. for promotion to professor of computational medicine and bioinformatics, with tenure, Department of Computational Medicine and Bioinformatics, Medical School, and professor of mathematics, without tenure, Department of Mathematics, College of Literature, Science, and the Arts.

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