Subject: Dissertation Defense - Herve Emissah, PhD in Bioinformatics & Computational Biology
Date: Monday, April 13, 2026 at 3:56:08 PM Eastern Daylight Time
From: SSB Faculty List on behalf of Diane St. Germain
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Dissertation Defense Announcement
To: The George Mason University Community

Candidate: Herve Emissah

Program: PhD in Bioinformatics and Computational Biology

Date: April 27, 2026

Time: 1:00 P.M. Eastern Time (US and Canada)

Location: via Zoom

Join Zoom Meeting

https://gmu.zoom.us/j/97100180296?pwd=DxPkzIVRf8O3Exlby0lvBmOxGEQxFL.1

Meeting ID: 971 0018 0296
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Committee Chair: Dr. Iosif Vaisman

Committee Co-Chair: Dr. Giorgio Ascoli

Committee Members: Dr. Aman Ullah, Dr. Bengt Ljungquist

Title: Standardization of Neural Morphology Using Automation and Machine Learning for Big Data Analytics

Abstract:

Digital reconstructions of neurons and glia are essential resources for studying neural morphology, cell types, circuit organization, development, and disease. Neurological and psychiatric disorders represent a major global health challenge and are a leading cause of disability and mortality worldwide. Understanding neural structure and connectivity is therefore critical for advancing neuroscience research and improving insight into brain function and neuropsychiatric disease. Achieving this goal requires accurate, standardized neural reconstructions and the reliable detection and correction of structural irregularities that may otherwise compromise downstream analyses and biological interpretation. As repositories such as NeuroMorpho.Org continue to expand, they enable broader comparative analyses, integrative modeling, and reuse of neural morphology data across the neuroscience community. However, the scientific value of these resources depends on two key factors: the availability of shared datasets and the reliability and consistency of the shared reconstructions. This dissertation addresses both challenges by examining the scientific impact of neural morphology data sharing and by developing computational infrastructure to improve the quality, scalability, and usability of shared neural reconstructions.

The first component of this research investigates the influence of open data sharing through a bibliometric analysis of neural morphology publications. Citation and reuse data from NeuroMorpho.Org, Semantic Scholar, and Europe PubMed Central were integrated into a database-driven analytical platform to compare publications that shared their neural reconstruction datasets with those that did not. The analysis demonstrates that articles associated with publicly shared datasets exhibit higher yearly citation rates and sustained long-term reuse. To increase transparency and recognition of these benefits, a web-based citation-tracking service was developed to enable researchers to monitor downstream citations and reuse of shared neural morphology datasets.

The second component presents a cloud-deployed computational platform for automated quality control and standardization of SWC-formatted neural reconstructions. The system integrates structural validation, normalization, anomaly detection, morphometric analysis, visualization, and reporting within a containerized architecture. Automated correction procedures address common reconstruction artifacts, including overlapping nodes, non-positive radii, spurious side branches, disconnected components, and anomalously long parent-child connections. In addition, a machine-learning-based dendritic relabeling method for pyramidal neurons was developed using morphology-derived features and graph-based classification, achieving highly consistent validation and test performance with a mean accuracy of approximately 99.5%.

Together, these studies demonstrate that open sharing of neural morphology data increases scientific visibility and reuse, while automated computational approaches can substantially improve the reliability, consistency, and scalability of shared neural reconstructions. By combining bibliometric evidence with scalable quality-control

infrastructure, this dissertation contributes computational approaches and empirical insights that support more reproducible, accessible, and reusable neuroscience data.

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