

Mathematics Colloquium

Topological data analysis of pattern formation in stem cell colonies

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11:10 am – 12 p.m.
Building 38, Room 204

Abstract

Confocal microscopy imaging provides valuable information about the current expression states within in vitro cell cultures. However, few tools exist to quantify the spatial organization of the cells observed in these images. In this talk, we focus on studying the pattern formation of human induced pluripotent stem cell (hiPSC) cultures, which have become powerful, patient-specific test beds for investigating the early stages of embryonic development. We present a modular, general-purpose pipeline that extracts cell-specific signal intensities from confocal microscopy images. The pipeline then assigns cell types based on corresponding intensities and quantifies spatial information among cell types through topological data analysis (TDA). We provide an overview of TDA and discuss the biological insights which we gain from applying our pipeline to microscopy images of hiPSC colonies, including the detection and quantification of changes in pattern formation caused by cell-to-cell signaling and differentiation.

About the speaker: Dr. Cruz is a postdoctoral associate in the Laboratory for Systems Medicine at the University of Florida (Department of Medicine). Previously, he was a visiting assistant professor at the Georgia Institute of Technology affiliated with the Southeast Center for Mathematics and Biology (SCMB). During that time, he worked on modeling emergent patterns within pluripotent colonies of stem cells with professors Elena Dimitrova and Melissa Kemp. Dr. Cruz is interested in mathematical models motivated by biological systems which connect local interactions with emergent, system-level properties. In particular, he studies multiscale, computational models in which local (e.g. intercellular and/or biomolecular) communication gives rise to observable features (e.g. the presence or absence of pattern formation).