A GAME OF HIDE AND SEEK

INTERVIEW WITH
DR. HENRY ADAMS
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The hallmark phrase we all heard across the playground doesn't just apply to childhood games; the idea of evasion paths in a series of mobile sensor networks is actually quite similar. Think of yourself as an evader hiding from the sensors (the seeker). You try your best to stay hidden, and when the seeker gets too close, you try running to a different place without being caught. Now imagine there are several seekers and only one of you—the game becomes more challenging! Evaders in mobile sensor networks face this challenge too as they try to pass through sensors without detection.

More formally, sensor networks are defined as a group of sensors that collect data from different locations and send it to a central location for analysis. They are commonly used to monitor environmental conditions, to locate people during emergencies like building collapses, and to record wildlife population data for preservation studies. The evaders are intruders trying to navigate through these sensor networks without being detected.

Now we know what sensor networks and evaders are, but why are evasion paths important? Hypothetically, let's say enemy combatants have deployed a series of data-collecting sensor networks that our military needs to access. How can they do so without triggering any alarms? Here's where evasion paths come in: if the military can send an undetected evader into the enemy's sensor networks, they may be able to discreetly gather crucial intelligence.

So, how do we find these evasion paths? You might think it would be as simple as locating the specific sensor coordinates, but the sensors are constantly communicating and moving in different patterns, making it difficult to track movement—especially when the sensors may not be equipped with GPS devices. Successful data collection relies on more advanced methods of tracking the mobile sensors. While interviewing Dr. Henry Adams, an Assistant Professor in the University of Florida's Department of Mathematics, he explained how we can use topological methods to construct a sensor connectivity map. The map then allows us to approximate the location of the sensors, leading us to a viable evasion path. Topology can help us analyze connectivity and identify potential paths in a sensor network.

"TOPOLOGY CAN HELP US ANALYZE CONNECTIVITY..."

Dr. Adams' research focuses on applied topology, machine learning, and sensor networks, amongst other subjects. He strives to make advanced mathematics accessible to students across the globe and serves as the executive director of the Applied Algebraic Topology Network (AATRN). The AATRN is an extensive network that provides educational resources related to algebraic topology by hosting online seminars and uploading helpful topological tutorials on its YouTube channel. One of the regular contributors to the channel is Péguy Kem-Meka, an African doctoral student advised by Dr. Adams. Dr. Adams can take such an active role in Kem-Meka's work largely because of Quantum Leap Africa, a program aimed at expanding mathematical education in over ten African countries.

During his graduate program at Stanford University, Dr. Adams focused on zigzag persistent homology, a type of homology (the topological dimension of a shape) that captures changes in connectivity over time. Unlike persistent homology, zigzag persistent homology can trace non-linear up-and-down movement. This feature—and by extension Dr. Adams' research—is very helpful when examining sensor connectivity maps. With a more accurate picture of the sensors' complete movement patterns, we are able to effectively form evasion paths around them.

Next time you play a game of hide and seek, remember not just to locate the seekers, but track their complex movement patterns. You might just stand a better chance of escape.