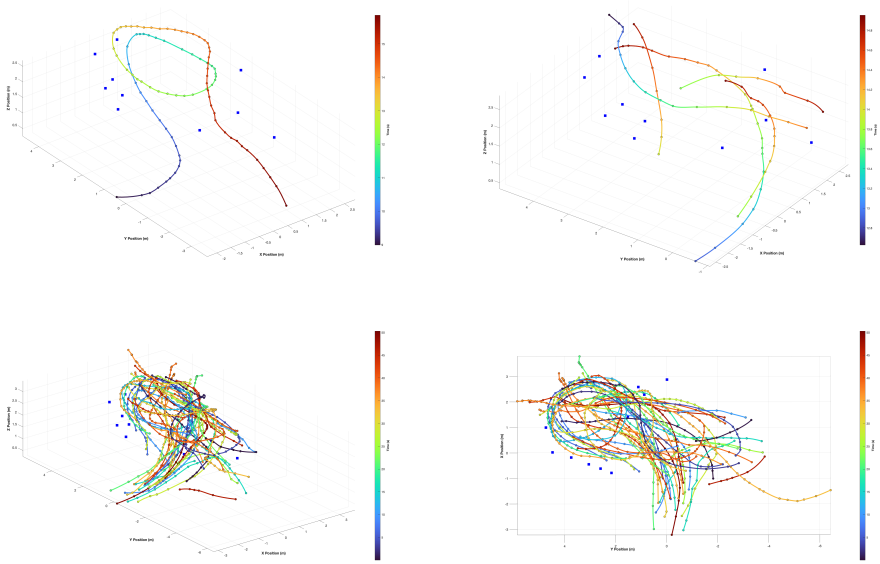
Eavesdropping on Bats: How Sound Reveals Their Hidden Flight Paths

In order to navigate in the dark, bats emit high-pitched echolocation calls. Usually, no one is around to listen, but if we place microphones in a cave, we can record these calls and actually pinpoint exactly where the bats are flying. We do this by first measuring the time that a call arrives at each microphone. Because sound travels at a specific speed, the time it takes for a call to reach a microphone reveals exactly how far away the bat is. When we combine the measurements of at least four different microphones, we can solve for the exact location of the bat. This method of figuring out the location of a sound source using the inferred distance to a collection of microphones is called Multilateration.

In this project, I developed a fully automated method to robustly solve the multilateration problem. The method synergizes many different techniques, ranging from using artificial intelligence to detect bat calls in the audio recordings, to advanced mathematical algorithms. My method successfully tracked a larger number of bats with higher precision than previous attempts, allowing us to map their tangled flight paths. The ultimate goal of tracking bats in this way is to understand how they behave and communicate in groups, and this project brings us one step closer to uncovering that mystery.



This is what it can look like when the audio recordings have been analyzed. The curves show the flight paths of bats moving around in the dark.