Dr. Robert Calderbank

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Dr. Calderbank directs the Rhodes Information Initiative at Duke University, where he is a Distinguished Professor. He is known for contributions to voiceband modem technology, to quantum information theory, and for co-invention of space-time codes for wireless communication. His research papers have been cited more than 50,000 times, and his inventions are found in billions of consumer devices. Dr. Calderbank was elected to the National Academy of Engineering in 2005, to the National Academy of Inventors in 2015, and to the American Academy of Arts and Sciences in 2022. He has received a number of awards, including the 2013 IEEE Hamming Medal for contributions to information transmission, and the 2015 Claude E. Shannon Award.

Title: Learning to Communicate

Abstract: It is common knowledge that a time-domain pulse is well adapted to pure delay channels, and that a frequency domain pulse is well adapted to pure Doppler channels. In this talk we will explain why the Zak-OTFS waveform, a pulse in the delay-Doppler domain, is well adapted to the doubly spread channels that arise in wireless communication.

We will describe how to design the Zak-OTFS waveform so that the input-output (IO) relation is predictable and non-fading, and we will explain how it is possible to learn the IO relation without needing to estimate the underlying channel. We will explore the possibility of a model-free mode of operation, which is especially useful when a traditional model-dependent mode of operation (reliant on channel estimation) is out of reach. We will also describe how the Zak-OTFS waveform supports combined communication and sensing by enabling unambiguous delay-Doppler estimation.

This is joint work with Saif Mohammed, Ananthanarayanan Chockalingam, and Ronny Hadani.