

# ECE DISTINGUISHED SPEAKER SERIES



## Robert Calderbank

Dean of the Natural Sciences  
at Duke University

**Host: Prof. Edmund Yeh**  
(eyeh@ece.neu.edu)

## Extending the Lifetime of Flash Memory

**Thursday**  
**March 28th, 2013**

Room 378 in 140 The Fenway  
4:00-5:00 pm  
*Reception to follow*

*Sponsored by the  
Department of Electrical  
and Computer Engineering*

Hard disk drives are losing ground to Flash because they do not support random access, their moving parts consume significant power and they have relatively slow read and write speeds. The recent adoption of non-volatile memory by large data centers is making a particular shortcoming of Flash more visible; the fact that a memory cell can only support a limited number of writes before it fails. Furthermore, this number is expected to decrease significantly as the minimum feature size of Flash transistors shrinks.

In this talk we describe how to extend the lifetime of Flash memory by increasing the number of writes that are possible before erasure is necessary. We introduce redundancy into the write process in order to decrease the number of memory cells that are impacted by a given write, and to even out the impact of writing across an entire page of memory.

We shall write data to memory in the form of a coset of a convolutional code. The coset is represented by a binary vector that is selected by the Viterbi algorithm to minimize the number of cells impacted by the write (Hamming weight) and to even out the number of writes to each cell within a given page. We show that lifetime gains of over 500% are possible with only modest encoding and decoding complexity.

*This presentation describes joint work with Adam Jacobvitz, John Marcus and Dan Sorin*

**Robert Calderbank** is Professor of Electrical Engineering and Dean of Natural Sciences at Duke University. Prior to joining Duke in 2010, he directed the Program in Applied and Computational Mathematics at Princeton University. Prior to joining Princeton in 2004 he was Vice President for Research at AT&T, responsible for what may have been the first industrial research lab where the primary focus was Big Data. Professor Calderbank is well 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 30,000 times and his inventions are found in billions of consumer devices. Professor Calderbank was elected to the National Academy of Engineering in 2005 and has received a number of awards, most recently the 2013 IEEE Hamming Medal for his contributions to information transmission.



# Northeastern

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