Wireless@VT and Beyond: Perspectives on the Past and the Future

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Claude Shannon had a dream ...

\[ C = \max_{p_X(x)} I(X;Y) \]

\[ I(X;Y) = \sum_{x,y} p(y|x)p(x) \log_2 \left( \frac{p(y|x)p(x)}{p(x)p(y)} \right) \]
When Shannon Published this work, radios looked like this:
And virtually all communications was analog:
But even then, some people thought that radios should look like this:
Virginia Tech entered this conversation in the 1960’s and 1970’s
Satellite Communications was one of the first applications for which Shannon’s ideas were feasible.
But the world changed, with the introduction of the cellular communications concept.
Cellular systems created a new urgency to understand the wireless channel
Never before had $p(y|x)$ seemed so complex
Virginia Tech students took wireless measurements everywhere.

Figure 2 – On-Chip sliding correlator channel sounder transmitter.
Understanding the wireless channel led opened up new avenues of research

And problems became opportunities
Multipath allowed the use of spread-spectrum and Rake Receivers
Fading led to equalization
Co-Channel Interference led to the use of DSP-Based Interference Mitigation

Asynchronous CDMA TRANSMITTER
AD-21020 Floating Point DSP

Multiuser Receiver
BER
JPEG Image

User 1
User 2
User K

Random Data
JPEG

DAC
ADC
Noise

User i
User K

AD-21020 Floating Point DSP
Independent Fading Led to MIMO

TX data → Vector Encoder → TX → TX → TX → Rich Scattering Environment → RX → RX → RX → RX → V-BLAST Signal Processing → RX data
And all forms of diversity were exploited
And Virginia Tech Students went everywhere in the wireless field
And shared some special moments
And sometimes had a little too much fun.
Many of the physical layer issues which had challenged since the 1940s were solved by the early 2000’s and research has evolved.
But there are many challenges still to be solved

- Cooperative networks
- Communications security
- Cognitive radio and spectrum sharing
- Position Determination
- Biometrics voice classification
- Applications of 4\textsuperscript{th} generation systems
- And every time $p(y|x)$ changes, the game changes once again ...
And Virginia Tech continues to be a part of solving those challenges