Thoughts on "Technical Enablers for Evolving Regulatory Processes"

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Everything old is new again …

- Radar is perhaps best known for it's impact in World War 2, air traffic control, and weather tracking

- Though today we see an explosion in radar for an increasing number of applications, such as
  - Automotive (collision avoidance, blind spot detection)
  - Hand gesture recognition
  - Tracking of space debris

- And just like the digital revolution led to our pocket super-computers, it is likewise driving radar innovation via
  - Large-scale AESAs
  - Agile waveforms
  - Dynamic/cognitive operation
  - More sophisticated interference cancellation
  - Multistatic/MIMO operation

The spectrum context

- Software-driven radar capabilities will enable mode/parameter selection at machine speeds …otherwise known as Cognitive Radar

- But despite the vast number of publications on the topic, we must move past the tendency for "over-abstraction" of signal/system modeling that is presently pervasive (greatly limits experimental, and ultimately operational, transition)

- Consider that radar requires:
  - High dynamic range (several 10s of dB)
  - High fidelity & coherency (for any kind of interference cancellation)
  - Often high dimensionality (for coherent integration gain)

- And yet must contend with:
  - Inherent transmitter distortion due to high Tx power (fidelity limiting)
  - Growing ubiquitous and dynamic interference (in addition to self-interference)
  - And increasingly a driver to share spectrum (mitigate mutual interference)

Some hurdles/opportunities

1. As more systems move toward software-driven operation, cognitive vs. cognitive will realize an arms race across different RF modalities
   - So add increasing nonstationarity to what radar must contend with … which impacts fidelity/coherency

2. The trend toward more airborne/space-based comm nodes adds elevation to interference mix
   - Terrestrial comm helped provide some spatial separability with radar … but this new vertical paradigm means more occurrences of intersection
   - More sophisticated radar interference cancellation is needed, including consideration of more computationally complex "joint domain" perspectives to increase degrees of freedom (multiplicatively) … but there's always the *curse of dimensionality* to consider
   - But that also assumes avoidance of saturating very sensitive radar receiver front-ends

3. Higher radar duty cycles may be a path forward
   - Solid state power amplifiers can realize the same "energy on target" using longer pulses at lower peak power
   - Emerging forms of nonrepeating FM waveforms can facilitate 100% duty cycle without ambiguity (unlike FMCW)
   - Lower peak power & higher dimensionality means less mutual interference … but also changes the nature of the interference perceived by comm systems (CW instead of pulsed "shot noise")

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