Generalized RF: Tunable and adaptable filters for reconfigurable front-ends

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For both military and commercial RF systems, reliance on static front-end filters remains a significant hurdle to realizing field-adaptable platforms that are simultaneously frequency-agile and protected against antagonistic and friendly interfering signals. Fixed filter characteristics inevitably lead to federated and banded transceivers whose flexibility are ultimately constrained by size, weight and power consumption concerns. In an effort to transcend these limitations and overcome these design tendencies, the Defense Advanced Research Projects Agency (DARPA) has sponsored several initiatives focused on the development of filter technologies exhibiting programmable transfer functions in addition to center-frequency and bandwidth tunability. One such program has demonstrated a five independent channel receiver tunable from 20 MHz – 6 GHz with programmable RF pre-selection, narrowband analog channelization for spectrum sensing, and tunable IF. A related effort has demonstrated evanescent-mode cavity filters with programmable inter-resonator coupling coefficients capable of transmit-side notch filtering with power handling in excess of 20 W. Tunable micro-electromechanical acoustic filters leveraging high-Q materials are also being explored for high speed spectral sensing. When interconnected with a flexible front-end architecture currently under investigation by several DARPA-funded teams in a separate program, these filters enable a new class of generalized RF transceivers which do not rely on protracted and expensive design cycles to react to new waveform standards or to changing requirements. As is the case with digital FPGAs, field-programmable RF transceivers enabled by tunable filter technology are expected to significantly impact the sustainability, upgradability and procurement of military radio platforms for communications, electronic warfare and signal intelligence applications.

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