Low-Loss Microfluidically Reconfigurable Multi-Throw RF Switches & Related Mm-Wave Beam-Steering Applications

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Microfluidics has recently attracted interest as a technique for realizing highly efficient and low-cost reconfigurable RF devices. By utilizing liquid or solid metals inside microfluidic channels, reconfiguration of antennas, frequency selective surfaces, and RF filters have been demonstrated potentially with high power handling capabilities. To alleviate the oxidization and low conductivity limitations of liquid metals, our most recent work focused on utilization of selectively metallized plates inside the microfluidic channels to achieve reliable reconfigurability across a broad frequency range.

This presentation aims to introduce a compact multi-pole switch design based on a recently demonstrated microfluidically reconfigurable switch concept (E. González and G. Mumcu, "Low-loss wideband feed networks for high gain microfluidic beam-scanning focal plane arrays," 2016 IEEE International Symposium on Antennas and Propagation (APSURSI), Fajardo, 2016, pp. 645-646). First, a novel design layout is pursued to significantly reduce the reconfiguration time needed to change between different states of the recently introduced single-throw switch. The compactness of the new design layout also exhibits wideband and low-loss performance in mm-wave frequencies. Subsequently, the design is improved to integrate several switching structures into a smaller area and achieve multi-throw functionality. Realizing this compact layout is possible by resorting to significantly thinner microfluidic channel walls (i.e. <0.8 μm as compared to 6 μm from our recent work). Due to the compactness of the design, actuation techniques alternative to external micropumps becomes possible. Specifically, experimental work carried out with piezoelectric bending actuators integrated nearby the switch will be discussed and the possibility of utilizing the switches in beamforming networks will be investigated.