Simulating CMUT Arrays Using Time Domain FEA

PZFlex is a commercial FEA software that has been optimized for the ultrasound industry and is commonly used to design piezoelectric ultrasound transducers. However, PZFlex is not commonly used within the CMUT research field. Nevertheless, it has an explicit modeling approach allowing large structures like CMUT arrays to be modeled and its transient analysis intrinsically supplies non-linear and broadband results from a single run. A 3-D model of a CMUT array is developed with multiple cells in each element and one active element surrounded by N passive elements. It is demonstrated that the electro-mechanics can precisely be predicted, within 3%, including the pull-in voltage and the spring softening effect. The transmit impulse response is simulated by deconvolving the extrapolated pressure with the excitation pulse, and it is in excellent agreement with the measured. It is shown that the impulse response can directly be used in Field II to assess the image quality of the transducer using the lateral, axial and cystic resolution for two different CMUT designs.