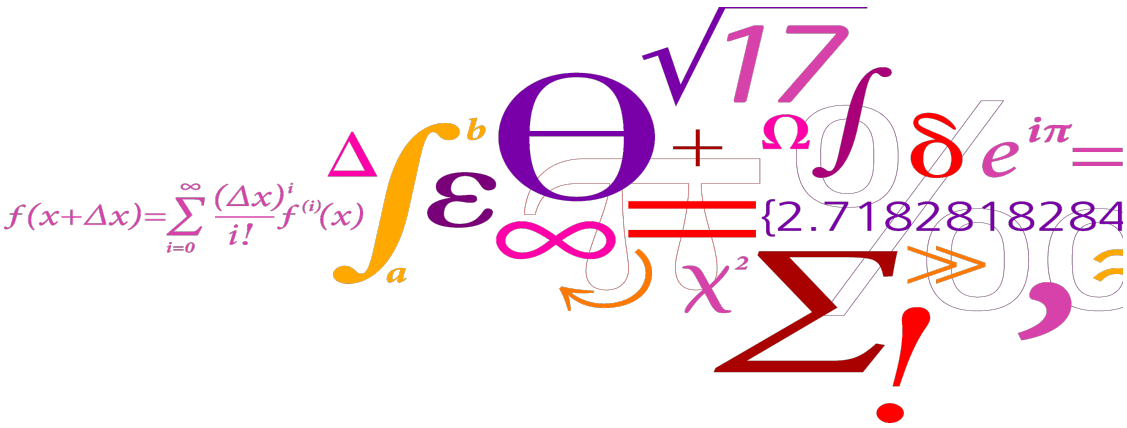
Problems

Design of PZT and CMUT transducers



Design of PZT thickness mode transducers

We investigate the design of PZT transducers. The transducer has 128 elements, and it has a pitch of $\lambda/2$. The dicing saw has a blade width of 20 μm.

Find the:

- thickness of the PZT
- pitch
- element width
- fill factor

for the following center frequencies:

- 3 MHz
- 8 MHz
- 15 MHz

Design of CMUTs

We now investigate the design of CMUTs. The transducer has 128 elements, and it has a pitch of $\lambda/2$. The transducers operates at a DC voltage of 200 V.

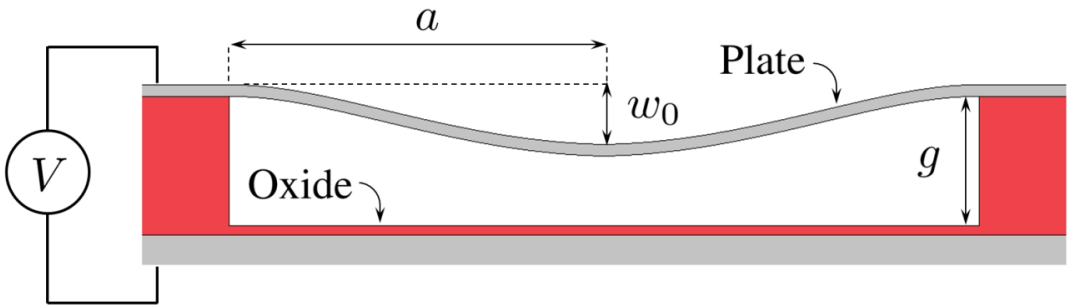
We will do our calculations for the following center frequencies:

- 3 MHz
- 8 MHz
- 15 MHz

Follow the CMUT design guidelines (see next page) and calculate the parameters mentioned in the guidelines.

Basic CMUT design methodology

1) Calculate pitch (λ or λ/2 or …) from wavelength in the media
2) Calculate element width (kerf almost zero or even negative)
3) Choose 2D cell layout (cell pitch, circles, squares, hexagonal …)
4) Fit circles into the element and determine radius, *a*
5) Find the plate thickness, *h*, to match immersion frequency
6) Select pull-in voltage ≈ 1.25 × V_{DC}
7) Adjust gap, *g*, to reach pull-in voltage
8) Check performance (bandwidth, pressure, PE sensitivity)
9) Check for substrate ringing and array effects ("Bragg" frequency)
10) If (performance < specs) goto 3
11) Check design with a full Finite Element model



Width ≈ Pitch = λ/2