EE 147/247A Prof. Pister
Fall 2020

EE247A Final Project

The final project will be a 4 page research paper in standard IEEE two-column format. The goals of the project are

- To read, understand, and cite at least five research papers relevant to your topic
- To design and analyze a device or system in a ***standard process***.
- To find some area in which you can make a contribution beyond the current state of understanding by doing a design in a standard MEMS process.

The constraint is that your project must use a standard process. It would be great if we had simulators that would let you design MEMS processes, but such simulators do model the real world well enough to let you do a realistic job. Process design in MEMS is still all about solving the myriad little problems that crop up in a real clean room. So we won't be doing any process design.

Standard processes include any of the MUMPS processes that are offered (poly, SOI, piezo, metal), and "standard CMOS" process, where someone else does the CMOS fab and there's just some simple post-CMOS processing (e.g. XeF2 etch, Fedder-style RIE, Xie-style backside DRIE + front side RIE) or one of the commercial processes (e.g. Nasiri, TSMC, …). Other examples include doing die-to-die bonding of two or more MUMPS processes (e.g. polyMUMPS to SOIMUMPS) using the gold bond pads. If you can find a paper with a clear description of a different MEMS process, where you can explain what the design rules are and why, then I will probably let you use that process too.

In addition, a simple two-mask SOI process is OK, and in fact potentially available for you to use to fabricate your design. We will most likely have a homework late in the semester where you will design in this process, and we will fabricate those devices for you. Some process options are available as well. More details to follow.

Test structures

Anything that you are doing in your project that hasn't been done before should have a test structure. For example: You intend to bond a polyMUMPS die to a SOIMUMPS die by compressing the gold pads together in order to make a micro-ladybug. Your paper is obviously about robot ladybugs, but you are relying on some properties of that bond: electrical conductivity, mechanical integrity, etc. You should have a model of how those vary with layout geometry, like the gold contact area. You put the physics/model equations in the paper, and a figure showing how your test structure is designed to measure the resistance and mechanical integrity as a function of some layout parameter (varying that parameter is what makes a test structure array), and a figure showing a plot of what you expect the results to be (the plot will just be the physics, but in a real paper you'd have the results of the measurements as well to compare).

Usually your test structure arrays are much more useful than your attempt at the full design.
People like to see theory and experimental data compared in the same plot - that's what
test structure arrays are for.

- Author list: this is your project, you should be the only author. If you got a lot of help from someone, you can put them in an acknowledgments section at the end.
- results: in any paper it is important to make clear whether results are experimental, simulated, or analytical. Presumably you won't have any experimental results, so there should be lots of phrases like "expected performance", "proposed design", and "simulated response" in your paper.

Deadlines

- [10/28] Email me a paragraph on each of two ideas that you might like to pursue. This can be very high level. Don't worry yet about whether or not it is possible.
- [11/11] Annotated bibliography – find and read at least five papers related to your topic. Take notes, and include summaries of them in the bibliography (that's what "annotated" means).

- [11/18] Detailed outline and at least five figures that need to be in the paper, including detailed captions and preliminary sketches of what the figures will look like. These figures might end up being simulated results of test structure arrays, block diagrams, layout, 3D sketches, …
- [11/25] preliminary layout, theory, simulation results
- [12/2] rough draft
- [12/{9,11}] presentations in class
- [12/9] final "camera-ready" copy. The author list should be your name, followed by “EE247A final project 2020”