**Principles for WFH:**

* Software
* Ideally low-effort, simple, and/or fun since it’s hard to engage in the project from home (we are also losing people)

**~~Thermal Simulation~~**

**Specific build shapes**

Manually look at common build shapes and theorize how to optimize printing them using a traditional printer. This would ultimately contribute to a library which could host optimized print patterns.

For example, bridging: are there ways to bridge without blasting air at it? Can we print in a ballistic trajectory and plan for deformation?

Shells: can you have a user reorient the print and conformally print on top of it to minimizing staircasing and discontinuities?

**Low-cost open-source arm printer**:

I imagine this is a really simple project. Everyone working on it would get a lot of experience with software and robotic manipulators.  
  
This might alternatively be really fun. Low-cost design is more about critical thinking and random ideas as opposed to deep intellectual thought and breakthrough. We’re talking laser-cut wood and carbon fiber plates (<https://stanfordstudentrobotics.org/pupper>). This will have more of a product-oriented approach as opposed to scientific novelty. Like Stanford Pupper, this idea would end up open-sourced and available to the public. We also don’t have to collect that much data since this is really just engineering design.  
  
We’ll be competing with printers in the market: <https://3dsourced.com/3d-printers/best-cheap-3d-printer/> (starts at $100)  
  
Software for control and IK are already open-sourced, our greatest contribution is putting together a flimsy (but functional) robotic arm that can print small objects that won’t require the operator to have engineering knowledge (consumer-friendly). There are also plenty of robotic arm designs online. Advantage of using an arm over a 3-axis is the ability to orient the print head, suggesting we still do conformal printing (i.e. a 3-axis will never be able to print a hemisphere without staircasing). Prototypes can be driven back and forth between homes/apartments if necessary.

Possible ways to expand:

* Throw on random sensors and try other control methods
  + Camera + computer vision = DIY closed-loop printing?
  + Precise scale as test bed = feed rate control?
* Multi-tool usage for pre/post processing

**Continue with conformal printing for repairs**

* **IFF we have access to RRL**

Goals:

* Study the effects of different printing techniques on samples

Novel:

* Material properties study on 3d printed structures
  + Control
  + “Damaged”
  + Repaired

Steps Needed:

* Printer up and running by end of this semester
  + Hard one - Really need a lot of time for this
  + This includes
    - Arm
    - Extruder
    - Toolpathing
  + Should have a cube printed by end of semester
* Boil down structures/damage
  + Create a representative model for general “damage”
  + Ideally something simple: I beams, cubes
  + As many flat surfaces as possible
    - Remember that the conformal part isn’t as important, it’s the repair
  + Stretch goal would be curved surfaces (such as fillets)
  + Honestly this could possibly be done with a standard 3-axis FFF printer?

I think this allows for a very concrete deliverable. It would definitely be challenging and require a lot of commitment.