### Test geometry

No upper bound, lower bound is negligible compared to constraints for extruder (by size).

### What we will accomplish (see gantt chart for Spring 2020)

Test available scanning instruments and determine “best” one by resolution, deployment, feasibility, noise, and size. A decision matrix can be used prior to determine scanning method for completeness (triangulation, ranging, tactile) - more research is needed for real values.

Determine **final scanner to be used in prototyping and testing**. Write/obtain software for converting scan data to point cloud (may be provided already from student code). Possible Software: Autodesk ReCap

**Plans for Minimum Viable Product** and month and a half’s worth of progress.

### What to research

Scanner **resolution** and parameters. Existing research values for **comparison of scanning methods**. If scanner is finished with time, begin researching toolpathing algorithms, designing new ones. After finding an algorithm, the system (operating system/hardware) will need to be taken into account for implementation. So we need to research what hardware has been used to decide what to use.

### What’s needed from other subteams

Rough dimensions of void. Physics/properties of materials at certain angles or contact points for a print (greatest range of extruder angles for print as a function of angle with the surface and gravity). Size of extruder/type of extrusion. Manipulator kinematics. Manipulator software for control.

### Plan B

If implementing/testing scanner takes longer than the beginning of February, on campus scanners can be looked at. Such as scanners in the UMD makerspaces. If toolpath algorithms cannot be effectively made and tested, try to verify the iso-layer one and focus on that one. If scripts are not found uhhh not good.

### Novelty

Scanning section seems to novel, little to no research on generating toolpaths on in-situ environments.

### What “things” we will be using

| Process | Software |
| --- | --- |
| 3D Scanning | Python, Arduino |
| Point Cloud Filtering, Mesh Generation | ReCap, MeshLab, MATLAB? |
| Modeling Repair | Autodesk Inventor |
| Generating ToolPaths | Python |
| Running Printer | Arduino (Marlin?), Python |

### Autonomy

Autonomy for scanning will involve semi-autonomous scanning but fully autonomous mesh and toolpath generation. Meaning, scanning bounds can be manually input (laser scanning should occur autonomously without input), but converting point cloud to mesh and developing a toolpath should be autonomous. This could then be fed off to the control software for the manipulator (and probably the extruder)

### Plans for Independent Testing

* Scanning
  + Process test point cloud data
  + Test scanner on calibration objects (spheres, cubes, etc.)
  + Test scanner on realistic object (actually damaged surface)
* Toolpath
  + Use simple sample mesh (cube, sphere, etc.) and generate toolpath
  + Use sample mesh to generate conformal toolpath on simple mesh (half circle, cube, etc.)
  + Use scanned mesh to generate toolpath for simple repair
  + Generate G code or similar type of code for use on arm/printer

### Plans for Dependent Testing

In the case that the manipulator is ready during the next semester (or whenever it is ready), we will begin generating test toolpaths to evaluate the kinematics and response of the arm to our commands. Extruder tested for flow rate control.

### Budget

As of right now we expect it to be **$0** (we are using mitchell’s stuff and open source/university software). What may change this is hardware for controlling the arm/printer such as an arduino or motor controller but that should be >$50

1. Acceptable test geometry

* No upper bound (definitely bounded by workspace)
* Lower Bound is negligible (definitely bounded by extruder)

1. What will you be doing next semester?

* Testing and getting data on triangulation scanner
  1. What must be designed?
     1. What are the requirements of the design?
  2. What will you do if you discover a certain design won’t work?
     1. What are your backups?

1. What will you accomplish by the end of the next semester?
   1. Deliverables
2. What do you want to explore in terms of research?
   1. Methods
3. What resources do you need from Dr. Mitchell?
   1. If you can’t get those resources, what would your budget look like?
4. What do you need from each subteam?
5. What will you bring to the research? In what way is the work or plan novel?
   1. Tests
   2. Methods
   3. Verification of prior research models/proposals for future work
6. If you discover that your goals or methods are too complicated, what will you do?
   1. Take a step back and evaluate exactly what needs to be done and see if there is a more simple solution.
7. **In general, if you were to start tomorrow, what needs to happen? How will you make it happen? When are your deadlines?**

This is mainly for subteam liaisons:

1. How will you manage your subteam and ensure that your deadlines are met?

SLACK

High-Level Requirements

Overall

* ~~Determine the dimensions of the void~~
* ~~Determine the shape of the void~~
* Finalize the dimensions and shape after combining findings and requirements of each subteam
* Define autonomy (overall and for your subsystem)
* Plans for independent testing
* Plans for dependent testing
* Determine high level requirements for your own subsystem

Scanning

* Determine dimensions and shape of void (range of measurements)
* Determine the type of scanning method(s) to use
* Determine software to use for every step
* Determine algorithm to create toolpath
* Budget
* Plans for independent/dependent testing