

PROGRESS REVIEW 2

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Team F / ADD_IN

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Individual Progress

For this week, my tasks entailed working further on the Slic3r commands invoked using MATLAB. In particular, they included:

- Loading the Slic3r configuration file through MATLAB script to set advanced slic3r settings for our MakerGear M2 3D printer
- Modifying the code that accepts insertion layer heights so as to make it more robust and fool-proof

Slic3r Configuration File

The Slic3r code written during the previous week used the default print settings to generate G-Code. These included necessary settings such as extruder diameter, filament diameter, bed size, layer height, etc. which vary according to the printer specifics. While using Slic3r via the command line, these settings must either be set one-by-one, or they could be altered by feeding a '.ini' configuration file along with the '.stl' file to be sliced. This is done by the command:

```
slicer.pl my_model.stl -load my_config.ini
```

Since there are about 150+ settings, feeding them one was not an option. We therefore generated a Slic3r configuration file 'my_config.ini' with the required settings using the Slic3r GUI. Last week however, we were unable to see the settings reflect on the G-code despite using the above command.

Through close inspection, it was found that the configuration bundle generated by the GUI had to be modified slightly to enable compatibility. It contained certain statements in brackets that had to be removed for the configuration file to load. The problematic lines were removed using 'strrep' in MATLAB, thus enabling us to generate G-code files tailored to our printer.

Slic3r code for insertion layer

Last week's MATLAB script proved that it was possible to modify the G-code to pause at a given insertion height. This script however was not capable of handling erroneous inputs or multiple insertion layers. Hence, one of this week's tasks included extending the capabilities of the MATLAB script. These include:

1. File Selection

The user must select one '.stl' file of the 3D part and one '.ini' file containing the configuration bundle. During the selection of each file, the user is prompted if he/she has selected a wrong file type and is asked to try again.

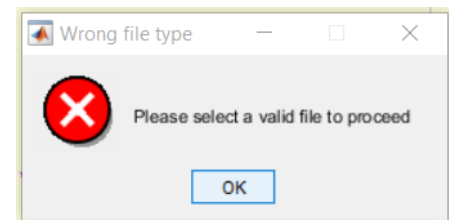


Figure 1 : Error displayed at selectin of wrong file type

2. Configuration File correction

As mentioned earlier, the configuration bundle generated by the Slic3r GUI must be edited for compatibility. This is done by replacing the error producing lines with blank spaces. One example includes:

```
config = strrep(config, '[filament:Simple Mode]', ' ');
```

3. Acceptable layer height

Once the STL and INI files have been read, the G-code is generated. We then search for all the Z axis commands in order to find the height of the top most layer. Acceptable layer heights include those between 0 and the found maximum height of the part. The script asks the user how many insertion layers have to be included, followed by producing a dialogue box to enter each of them. Some error handling messages include:

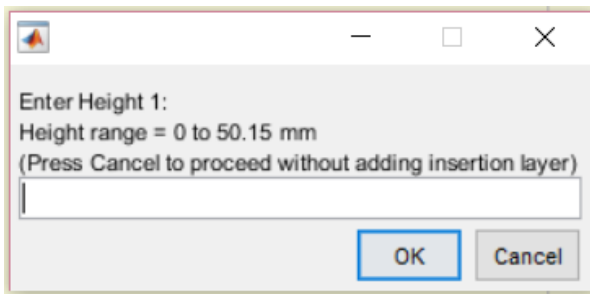


Figure 3: Dialogue box to enter height

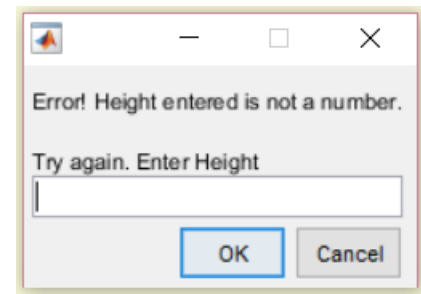


Figure 2: Error message if value entered is not a number

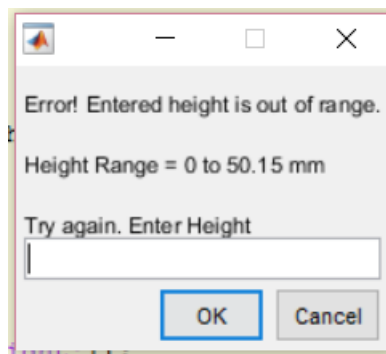


Figure 4: Error message is value entered is out of the range of the 3D part

4. Pause Sequence modification

Since the insertion time might be long enough to vary the temperatures of the nozzle and bed, we have inserted the command 'M

```
pauseSequence = 'G01 X0 Y200 Z170
M0
M190 S60 --Set bed temperature
M104 S220 --Set extruder temperature
M109 S220' --Wait for temperature to be reached.
```

Challenges

As part of the software team, installing the source code of the GUI has proved to be rather challenging so far since none of us are proficient in perl. For now, however, we are relying on MATLAB to invoke Slic3r. The GUI will only become critical in the Spring semester when we will want to remove our system's MATLAB dependency. Hence, we are turning this into an ongoing issue and hope to be able to modify the GUI by spring.

Personally, I have not faced many challenges this week. The challenges mostly lie in the tasks of the coming weeks where the software team we have to figure out how to generate 4th DOF data.

Teamwork

The team split up the tasks in the following manner:

Daniel Berman

Dan was in charge of troubleshooting the perl module that is creating an error while downloading the source code of the Slic3r GUI. It seems, however, like there is very little documentation for errors such as this. As a result, he has written an email to the author of Slic3r with details of the issue. We are hoping for a prompt reply. In addition, Dan was also engaged in writing the conceptual design for the PCB assignment. He also worked on editing the functional architecture for the System's Engineering presentation

Ihsane Debbache

Ihsane conducted extensive research about various nozzle designs used in 3D printers and developed a new design for the bent nozzle. He also worked on drawing up the SVEs for the System's Engineering presentation.

Nikhil Baheti

Nikhil was in charge of making the CAD models of the nozzle, heat block and barrel. These include both, the current design and the conceptualized bent one. He too was engaged in the project management aspects of the System's Engineering assignment

Astha Prasad

In addition to all mentioned above, I too was handling System's Engineering tasks which involved mapping the FVEs to the requirements put forth in our CODR.

Future Goals

Our goals for the next 2 weeks include:

1. Dan and Ihsane: Machining of the new bent nozzle
2. Nikhil and Ihsane: Test the bent nozzle.
3. Astha and Dan: Research 4DOF G-code generation using MATLAB
4. Astha: Schematic for the PCB assignment.
5. Astha: Research path planning algorithms.

6. TEAM: Work on the upcoming PDR

MATLAB Code

```
dansComputer = false;

%% Select STL file
file = 'empty';
configFile = 'empty';

while(~strcmp(file(end-3:end),'.stl'))
    if dansComputer
        cd '~/Slic3r'
        [file,path] = uigetfile('~/Desktop/*.stl','Select .stl File');
    else
        cd 'C:/CMU/Courses/Project/Slic3r';
        [file,path] = uigetfile({'*.stl'},'Select .stl File');
    end

    file = strrep(file, '.STL', '.stl');

    if(~file)
        break
    end

    if(~strcmp(file(end-3:end),'.stl'))
        errordlg(['Please select a valid file to proceed'], 'Wrong file
type');
    end

end

%% Select and correct configuration file
while(~strcmp(configFile(end-3:end),'.ini'))

    if dansComputer
        cd '~/Slic3r'
        [configFile,configPath] = uigetfile('~/Desktop/*.ini','Select
Configuration File');
    else
        cd 'C:/CMU/Courses/Project/Slic3r';
        [configFile,configPath] = uigetfile('../Desktop/*.ini','Select
Configuration File');
    end

    if(~configFile)
        break
    end

    if(~strcmp(configFile(end-3:end),'.ini'))
        errordlg(['Please select a valid file to proceed']);
    end

end
```

```

end

config = fileread([configPath,configFile]);

config = strrep(config, '[filament:Simple Mode]', ' ');
config = strrep(config, '[presets]', ' ');
config = strrep(config, '[print:Simple Mode]', ' ');
config = strrep(config, '[printer:Simple Mode]', ' ');
config = strrep(config, '[settings]', ' ');
config = strrep(config, '[simple]', ' ');
config = strrep(config, '%', '%');
config = strrep(config, '\\', '\\');

f = fopen([configPath, 'config.ini'], 'w');
fprintf(f, config);
fclose(f);

%% Generate Gcode
if dansComputer
    system(['./slic3r.pl ', [path, file], ' --load ', [configPath, 'config.ini']]);
else
    system(['slic3r.pl ', [path, file], ' --load ', [configPath, 'config.ini']]);
end

%% Get Z layer heights
Gcode = fileread(strrep([path, file], '.stl', '.gcode'));
[startIndex, endIndex] = regexp(Gcode, 'G1\sZ\d*\.\d*');

for i = 1:length(startIndex)
    Zlayers(i) = str2num(Gcode(startIndex(i)+4:endIndex(i)));
end

maxHeight = Zlayers(end);

%% Read Height from user
maxIL = 4;
numIL = inputdlg(['Enter number of insertion layers: ', 10, 10, 'Maximum = ', num2str(maxIL)]);
numIL = str2double(numIL);
if (~isempty(numIL))
    while (isnan(numIL) || numIL > maxIL || numIL < 0)
        if (isnan(numIL))
            usrInput = inputdlg(['Error! Not a number.', 10, 10, 'Try again (Between 1 and ', num2str(maxIL)']);
            numIL = str2double(usrInput);
        elseif (numIL > maxIL || numIL < 1)
            usrInput = inputdlg(['Error! Enter a number between 1 and ', num2str(maxIL), 10, 10, '(Press cancel to proceed without an insertion layer)']);
            numIL = str2double(usrInput);
        end
    end
end

else

```

```

    numIL = 0;
end

while(numIL)

    usrInput = inputdlg(['Enter Height ', num2str(numIL), ':', 10, 'Height
range = 0 to ', num2str(maxHeight), ' mm', 10, '(Press Cancel to proceed without
adding insertion layer)']);
    insertionZ = str2double(usrInput);

    if(~isempty(insertionZ))
        while( isnan(insertionZ) || insertionZ>maxHeight || insertionZ<0 )
            if(isnan(insertionZ))
                usrInput = inputdlg(['Error! Height entered is not a
number.', 10, 10, 'Try again. Enter Height']);
                insertionZ = str2double(usrInput);
            elseif(insertionZ>maxHeight || insertionZ<0 )
                usrInput = inputdlg(['Error! Entered height is out of
range.', 10, 10, 'Height Range = 0 to ', num2str(maxHeight), ' mm', 10, 10, 'Try
again. Enter Height']);
                insertionZ = str2double(usrInput);
            end
        end
        numIL = numIL - 1;
end

%% Modify if height was entered
if(insertionZ)

    ind = find(Zlayers>insertionZ,1);
    insertLoc = startIndex(ind);

    pauseSequence = 'G01 X0 Y200 Z170\nM0\nM109 S220\n';

    Gcode = [Gcode(1:insertLoc-1), pauseSequence, Gcode(insertLoc:end)];

    f = fopen([path, 'FinalGcode.gcode'], 'w');
    fprintf(f, Gcode);
    fclose(f);

    delete([configPath, 'test.gcode']);

end

```

Configuration file

generated by Slic3r 1.2.9 on Wed Oct 28 23:20:50 2015

```
[filament:Simple Mode]          ← Line to be removed to enable compatibility
bed_temperature = 0
extrusion_multiplier = 1
filament_diameter = 1.75
first_layer_bed_temperature = 0
first_layer_temperature = 200
temperature = 200
```

```
[presets]                       ← Line to be removed to enable compatibility
print = Simple Mode.ini
printer = Simple Mode.ini
```

```
[print:Simple Mode]            ← Line to be removed to enable compatibility
bottom_solid_layers = 3
brim_width = 0
dont_support_bridges = 1
external_fill_pattern = rectilinear
fill_density = 20%
fill_pattern = hilbertcurve
infill_speed = 80
layer_height = 0.2
perimeter_speed = 60
perimeters = 3
raft_layers = 0
support_material = 0
support_material_contact_distance = 0.2
support_material_spacing = 2.5
top_solid_layers = 3
travel_speed = 130
xy_size_compensation = 0
```

```
[printer:Simple Mode]         ← Line to be removed to enable compatibility
bed_shape = 0x0,200x0,200x200,0x200
end_gcode = M104 S0 ; turn off temperature\nG28 X0 ; home X axis\nM84 ;
disable motors\n
gcode_flavor = reprap
nozzle_diameter = 0.35
retract_length = 2
retract_lift = 0
start_gcode = G28 ; home all axes\nG1 Z5 F5000 ; lift nozzle\n
wipe = 0
z_offset = -0.6
```

```
[settings]                   ← Line to be removed to enable compatibility
autocenter = 1
mode = simple
```

```
[simple]                       ← Line to be removed to enable compatibility
avoid_crossing_perimeters = 1
```



```
bed_shape = 0x0,200x0,200x200,0x200
bed_temperature = 60
before_layer_gcode =
bottom_solid_layers = 3
bridge_acceleration = 0
bridge_fan_speed = 100
bridge_flow_ratio = 1
bridge_speed = 60
brim_width = 0
complete_objects = 0
cooling = 1
default_acceleration = 0
disable_fan_first_layers = 3
dont_support_bridges = 1
duplicate_distance = 6
end_gcode = M104 S0 ; turn off temperature\nG28 X0 ; home X axis\nM84 ;
disable motors\n
external_fill_pattern = rectilinear
external_perimeter_extrusion_width = 0
external_perimeter_speed = 50%
external_perimeters_first = 0
extra_perimeters = 1
extruder_clearance_height = 20
extruder_clearance_radius = 20
extruder_offset = 0x0
extrusion_axis = E
extrusion_multiplier = 1
extrusion_width = 0
fan_always_on = 0
fan_below_layer_time = 60
filament_colour = #FFFFFF
filament_diameter = 1.75
fill_angle = 45
fill_density = 20%
fill_pattern = hilbertcurve
first_layer_acceleration = 0
first_layer_bed_temperature = 65
first_layer_extrusion_width = 200%
first_layer_height = 0.35
first_layer_speed = 30
first_layer_temperature = 225
gap_fill_speed = 20
gcode_arcs = 0
gcode_comments = 0
gcode_flavor = reprap
infill_acceleration = 0
infill_every_layers = 10
infill_extruder = 1
infill_extrusion_width = 0
infill_first = 0
infill_only_where_needed = 0
infill_overlap = 15%
infill_speed = 80
interface_shells = 0
layer_gcode =
layer_height = 0.2
max_fan_speed = 100
```

```
max_print_speed = 80
max_volumetric_speed = 0
min_fan_speed = 35
min_print_speed = 10
min_skirt_length = 0
notes =
nozzle_diameter = 0.35
octoprint_apikey =
octoprint_host =
only_retract_when_crossing_perimeters = 1
ooze_prevention = 0
output_filename_format = [input_filename_base].gcode
overhangs = 1
perimeter_acceleration = 0
perimeter_extruder = 1
perimeter_extrusion_width = 0
perimeter_speed = 60
perimeters = 3
post_process =
pressure_advance = 0
raft_layers = 0
resolution = 0
retract_before_travel = 2
retract_layer_change = 0
retract_length = 2
retract_length_toolchange = 10
retract_lift = 0
retract_restart_extra = 0
retract_restart_extra_toolchange = 0
retract_speed = 40
seam_position = aligned
skirt_distance = 6
skirt_height = 1
skirts = 1
slowdown_below_layer_time = 5
small_perimeter_speed = 15
solid_infill_below_area = 70
solid_infill_every_layers = 0
solid_infill_extruder = 1
solid_infill_extrusion_width = 0
solid_infill_speed = 20
spiral_vase = 0
standby_temperature_delta = -5
start_gcode = G28 ; home all axes\nG1 Z5 F5000 ; lift nozzle\n
support_material = 0
support_material_angle = 0
support_material_contact_distance = 0.2
support_material_enforce_layers = 0
support_material_extruder = 1
support_material_extrusion_width = 0
support_material_interface_extruder = 1
support_material_interface_layers = 3
support_material_interface_spacing = 0
support_material_interface_speed = 100%
support_material_pattern = pillars
support_material_spacing = 2.5
support_material_speed = 60
```

```
support_material_threshold = 0
temperature = 220
thin_walls = 1
threads = 2
toolchange_gcode =
top_infill_extrusion_width = 0
top_solid_infill_speed = 15
top_solid_layers = 3
travel_speed = 130
use_firmware_retraction = 0
use_relative_e_distances = 0
use_volumetric_e = 0
vibration_limit = 0
wipe = 0
xy_size_compensation = 0
z_offset = -0.6
```