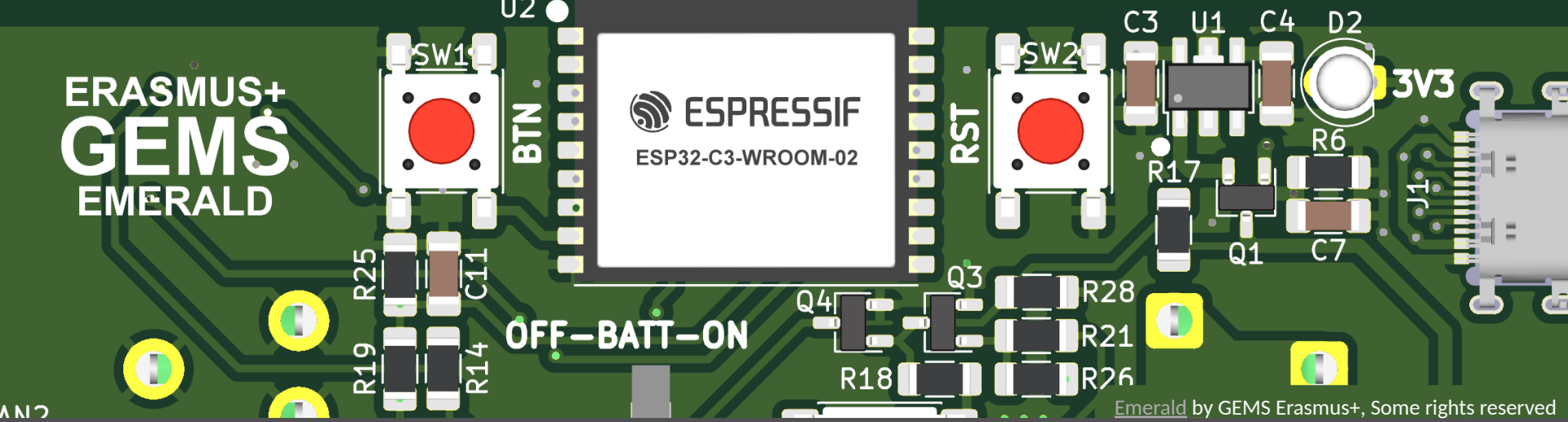

3D printing - Enabling robot manufacturing technology

Building Robots: System Integration

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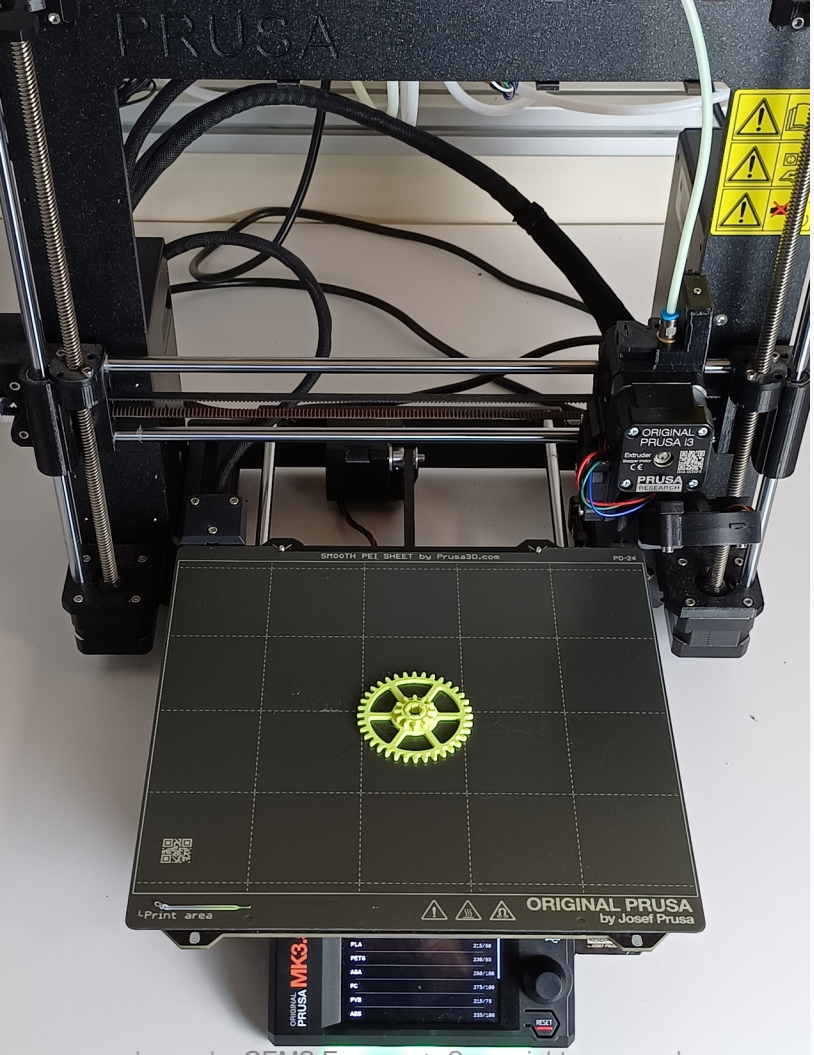
About

1. Process
2. Workflow
3. Limitations
4. Solutions

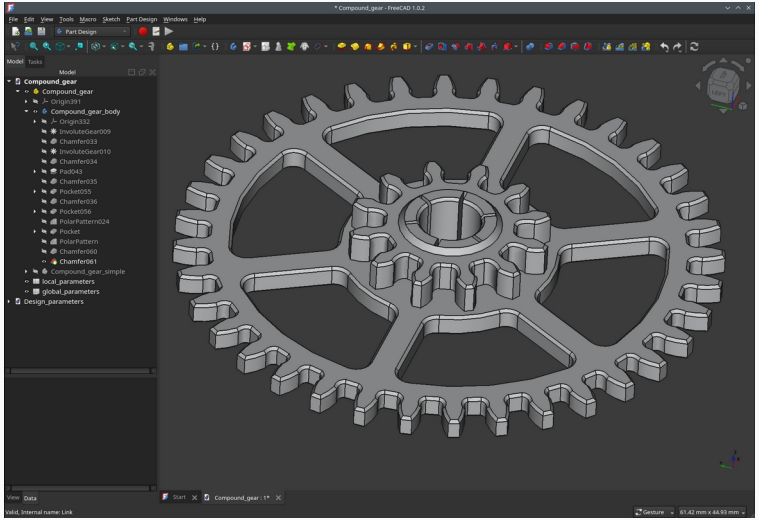
3D printing

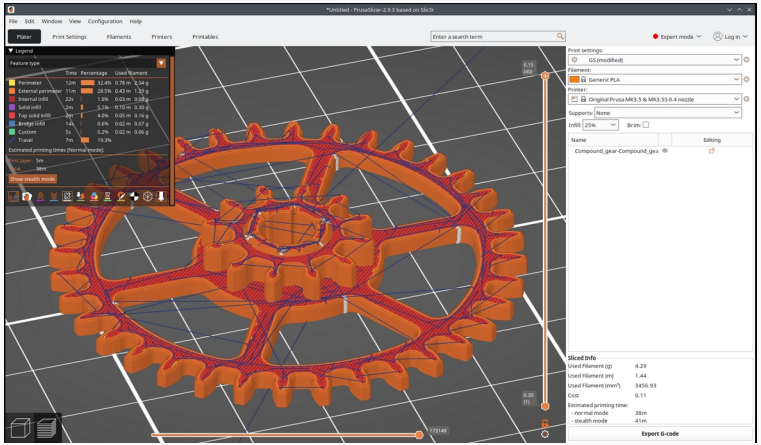


FDM 3D Printing process

1. Thermoplastic filament
2. Moving heated nozzle (melt → extrude → cool)
3. Extrusion in layers (2D + 1D → 3D)

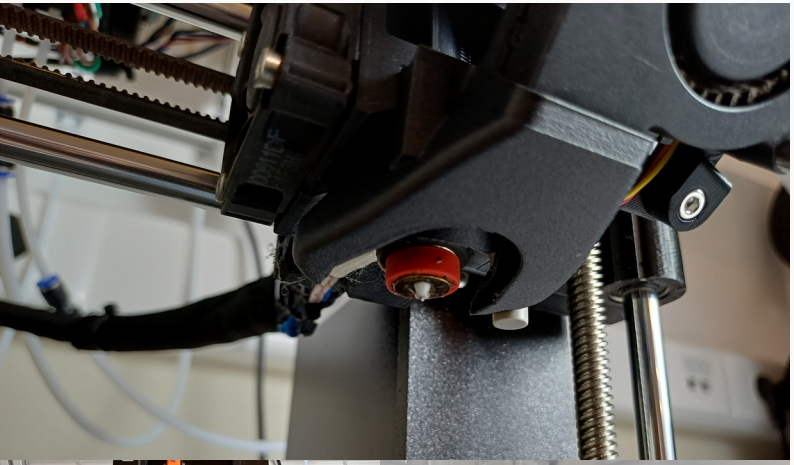
Workflow

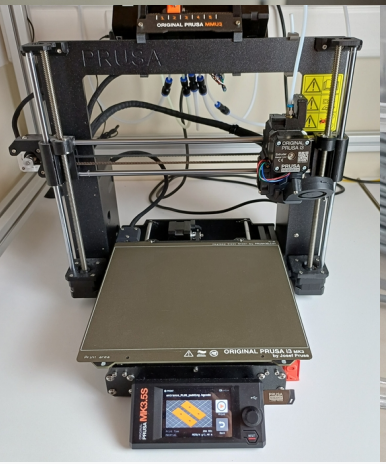




Tools

1. **CAD (FreeCAD)**
   Part design → export 3D object
2. **CAM → Slicer (PrusaSlicer)**
   Nozzle path → save program
3. **3D printer (Prusa mk3s+)**
   Final 3D printed part → post-processing

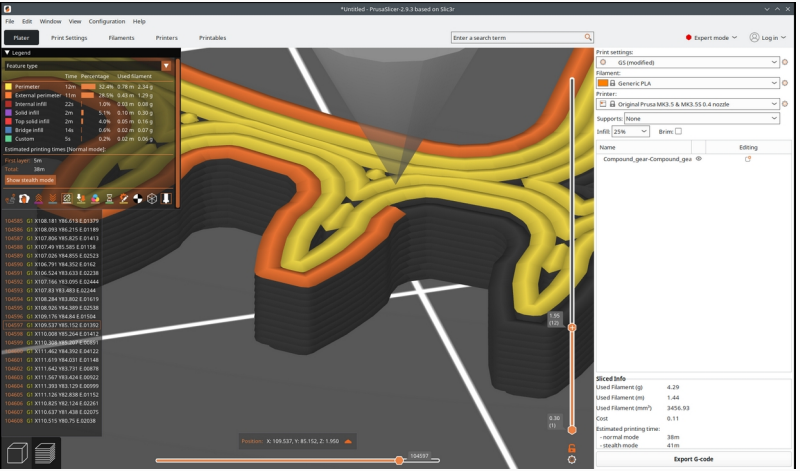


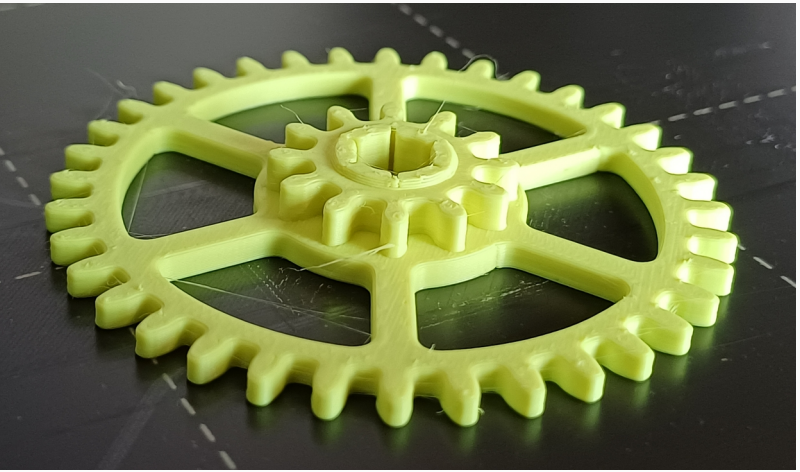


Configuration

1. Material → filament diameter, printing temperature
2. Nozzle → extrusion diameter, nozzle temperature
3. Part → layer height, N outer walls, infill percentage and pattern

Limitations

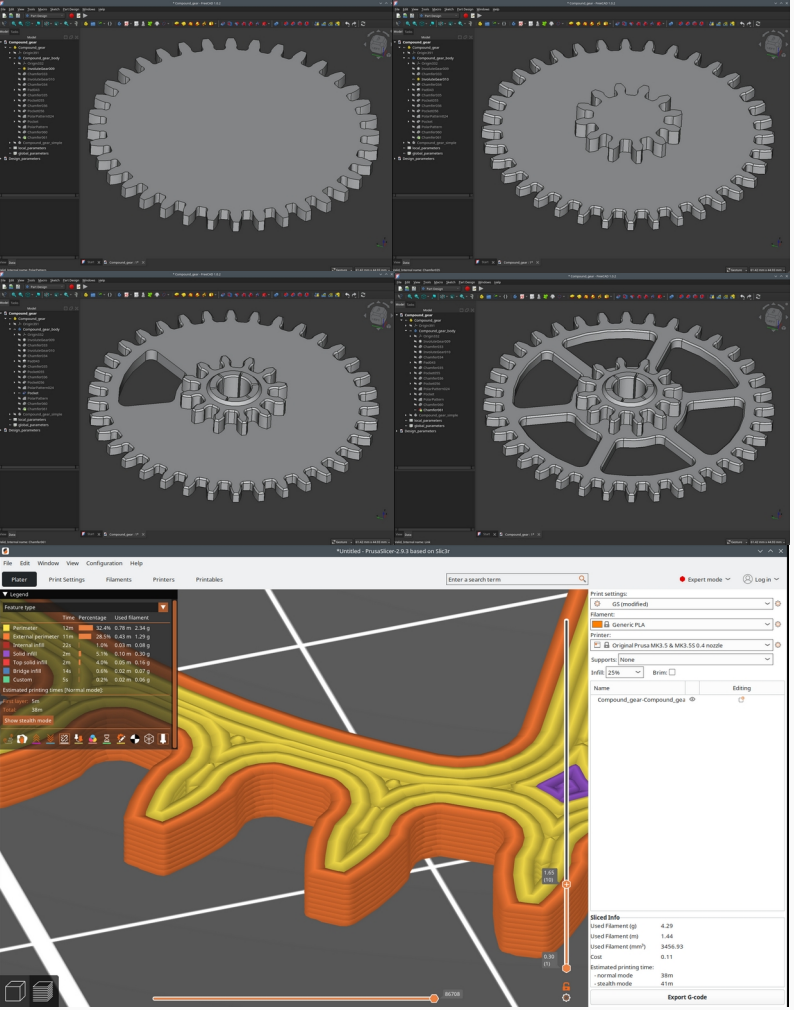




Causes

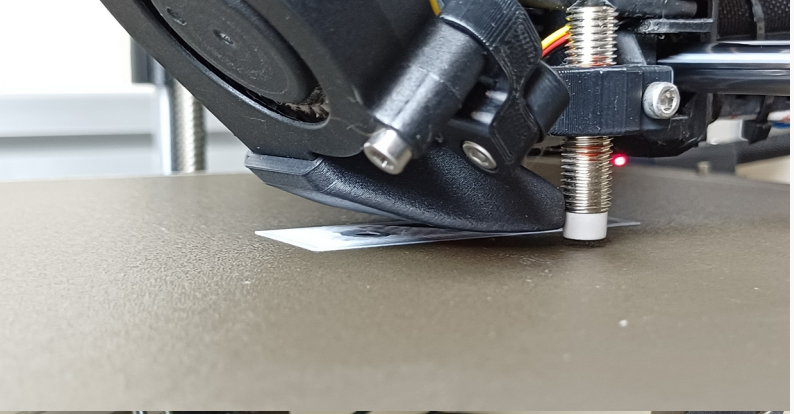
1. Layer stacking → lower tensile strength, overhangs with support
2. Inconsistent width of extrusion → poor tolerances and surface
3. Poor first layer adhesion → print failure

Solutions



Design for manufacturing

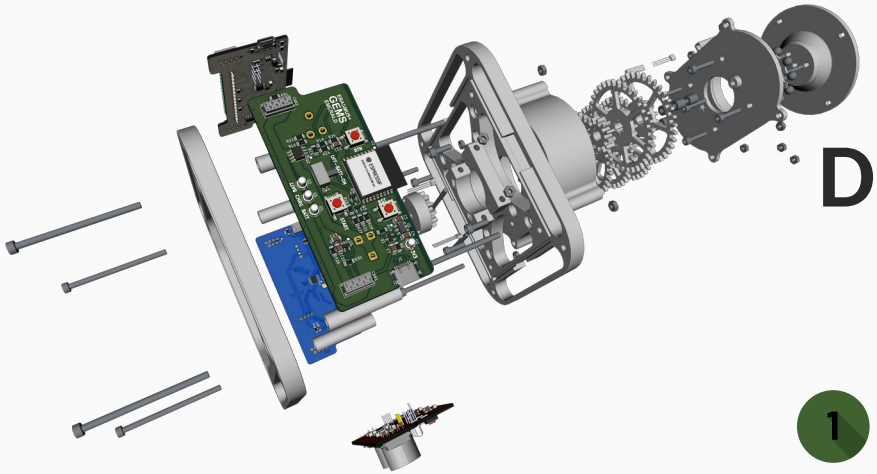
1. Part geometry based on layer and load direction
2. Nozzle size → defines the geometry of small details
3. Minimization of post-processing



Manufacturing process

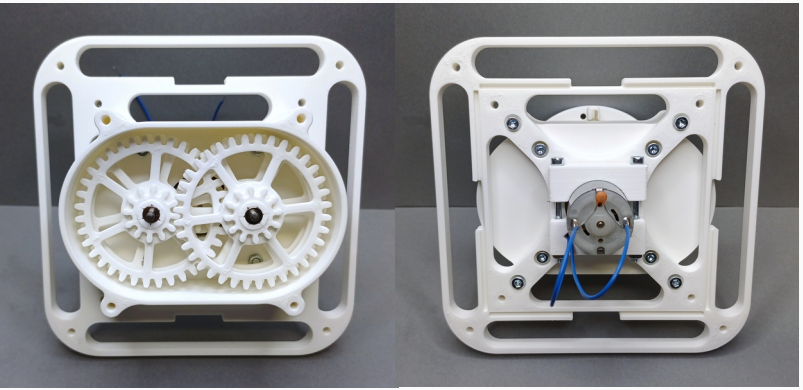
1. Dry fillament
2. Clean and heated build plate
   Surface material and texture
3. Supervision of first layer

Importance

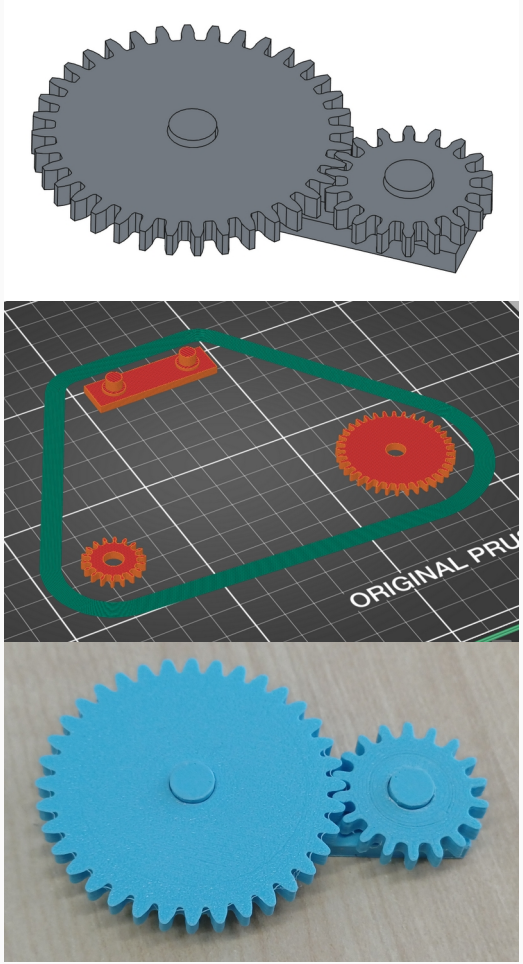


Design flexibility

1. Fast and inexpensive design iteration → small steps
2. Automated manufacturing process → time
3. Assembly driven design



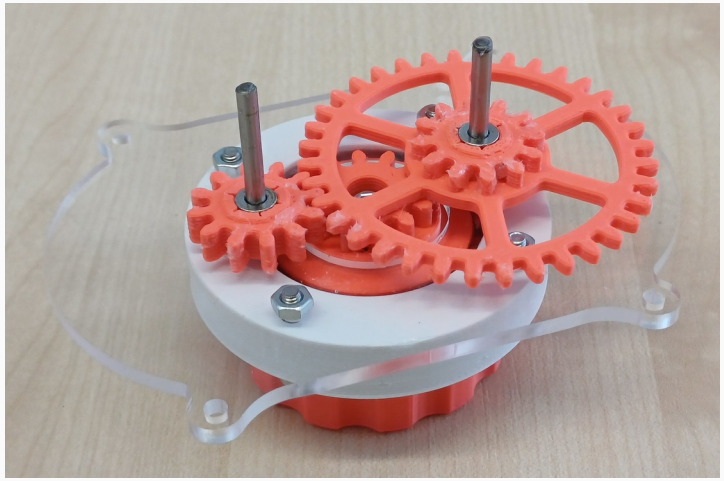
Task



Gear pair

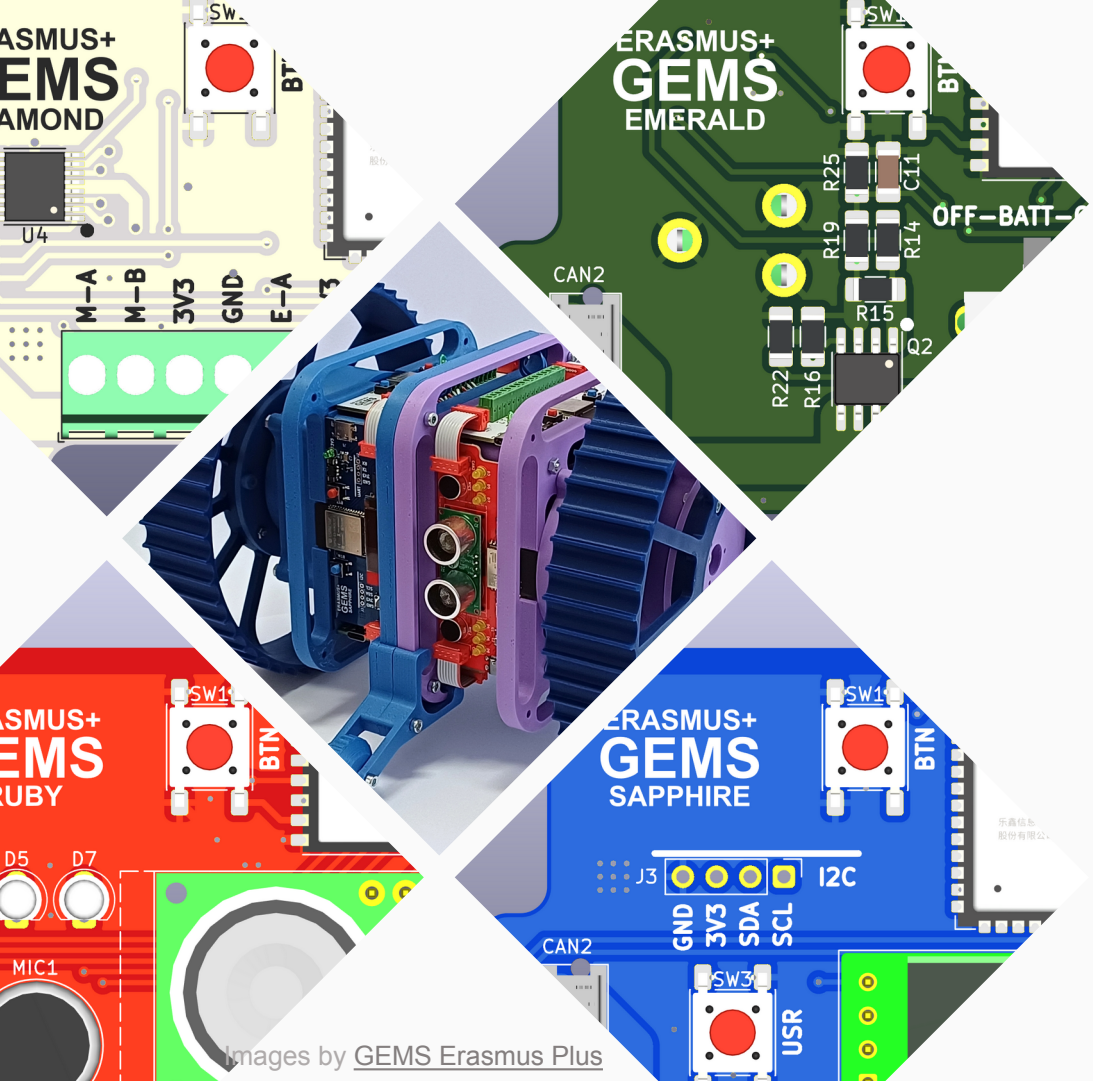
1. Reduction ratio: 3:1
2. Tooth: module (1.5mm), pressure angle (20˚)
3. Gears: Number of teeth (20 and 60)
   Center distance for meshing gears

Conclusion



3D printing for building robots

1. Versatile, but with limitations
2. Design for manufacturing process
3. Fast development pace



Thank you for watching!

This video was created by University of Ljubljana for the GEMS Erasmus+ project (a collaboration between University of Ljubljana, University of Alcala, Teaching Factory Competence Center, and Delft University of Technology).

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