



# VU-ISIS 2021 Internship Student Showcase

## Clay Wright



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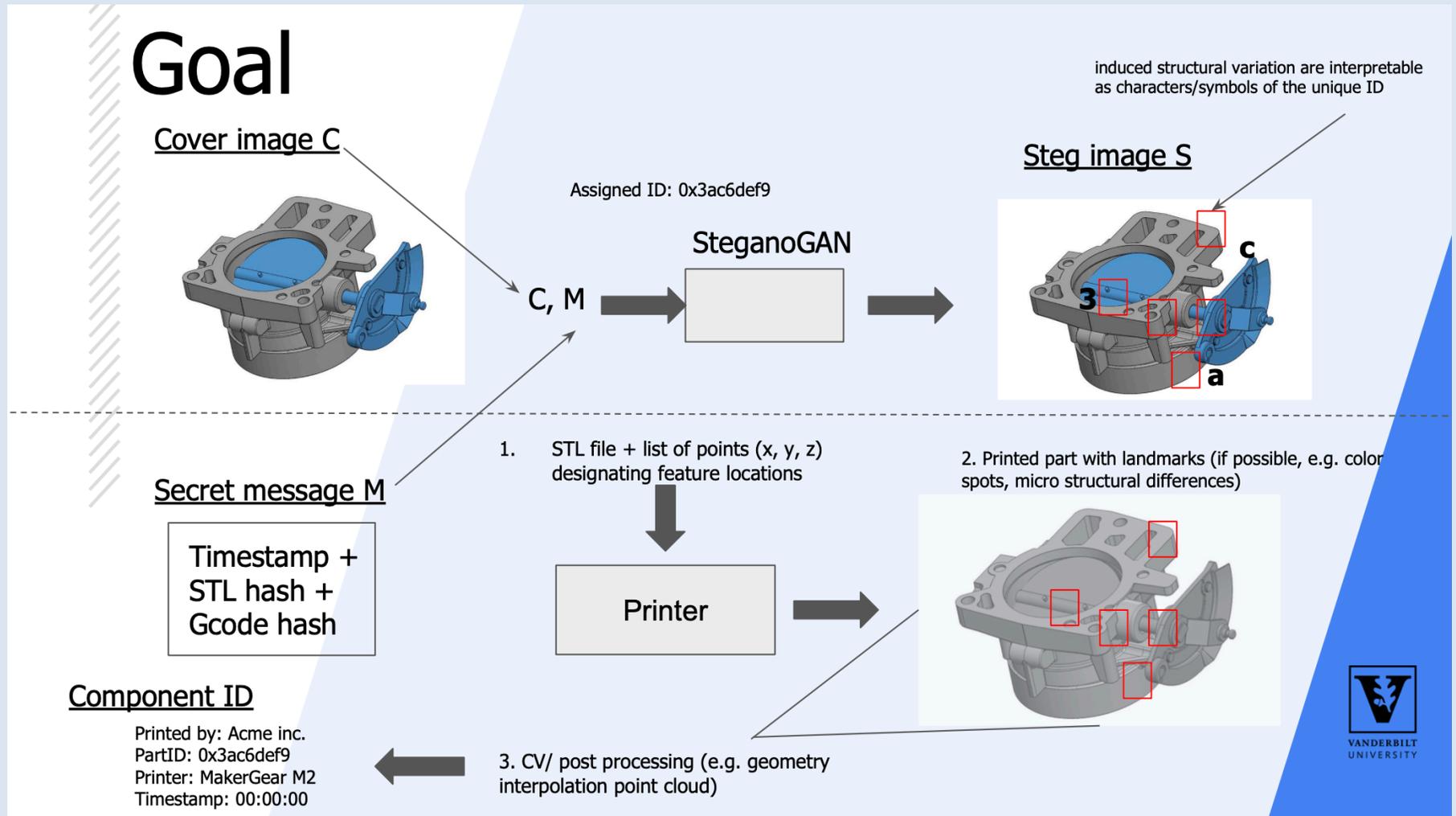


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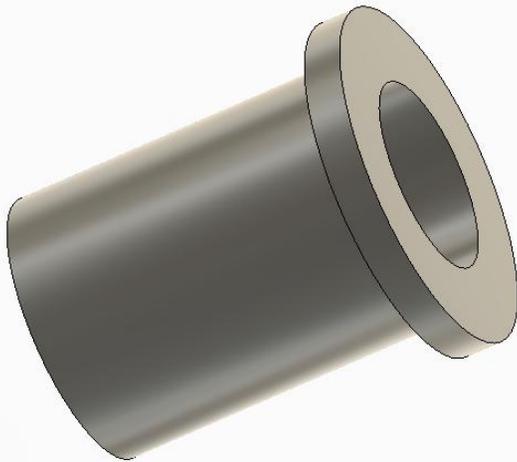
# Cyber-physical steganography with STL Data

- **Goal:** uniquely identify a 3D printed component by hiding metadata in an image of the CAD model that can be physically observed in the printed part
  - A consumer of the component can then identify a printed part by extracting this information from e.g. a picture of the part
- **Open questions:**
  - How can the hidden information be physically embedded/ recovered from the printed part? Directly/indirectly or via image/CT scan/etc?
  - Are there/what are the information-theoretic limits to hiding data in CAD image space? What aspects of a CAD image allow for more/less data to be hidden?
- **Code:** Steganogan has dependency issue, requires torch 1.0.0 which is unavailable
  - WIP: reimplementation, code: <https://github.com/sandbornm/isteg>
- **Data:** from Dimelab FabWave: 3D part repository for manufacturing research
  - Contains over 100,000 CAD models and the corresponding object's JPG, STL, STEP files
- **Paper:** paper with concept overview and experiment design
  - SCPS 2021 due July 31 (notification late August)
  - 2nd paper next semester that builds on/implements this idea

# System overview



# Dataset



JPG

```
ISO-10303-21;
HEADER;
/* Generated by software containing ST-Developer
 * from STEP Tools, Inc. (www.steptools.com)
 */

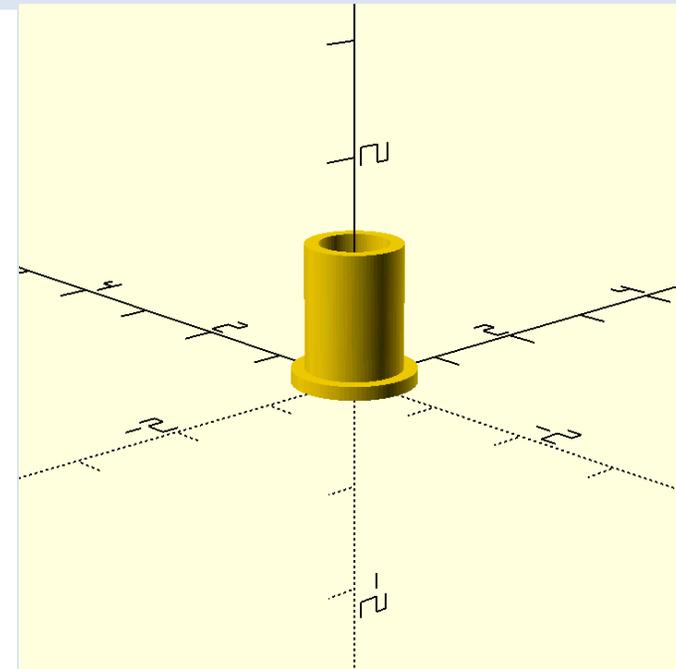
FILE_DESCRIPTION(
/* description */ (''),
/* implementation_level */ ('2;1'));

FILE_NAME(
/* name */
'G:\My Drive\CAD Repository\Bearings\STEP\00ed2536-3d80-4f07-8851
-4f49f1606498.stp',
/* time_stamp */ ('2018-04-02T12:04:42-04:00',
/* author */ ('bstarly'),
/* organization */ (''),
/* preprocessor_version */ ('ST-DEVELOPER v16.13',
/* originating_system */ ('Autodesk Translation Framework v6.5.0.72',
/* authorisation */ (''));

FILE_SCHEMA (('AUTOMOTIVE_DESIGN { 1 0 10303 214 3 1 1 }'));
ENDSEC;

DATA;
#10=MECHANICAL_DESIGN_GEOMETRIC_PRESENTATION_REPRESENTATION('',(#13),#180);
#11=SHAPE_REPRESENTATION_RELATIONSHIP('SRR','None',#190,#12);
#12=ADVANCED_BREP_SHAPE_REPRESENTATION('',(#14),#179);
#13=STYLED_ITEM('',(#199),#14);
#14=MANIFOLD_SOLID_BREP('Body1',#95);
#15=FACE_BOUND('',#29,.T.);
#16=FACE_BOUND('',#33,.T.);
#17=FACE_BOUND('',#35,.T.);
#18=PLANE('',#112);
#19=PLANE('',#120);
#20=PLANE('',#121);
#21=FACE_OUTER_BOUND('',#27,.T.);
#22=FACE_OUTER_BOUND('',#28,.T.);
#23=FACE_OUTER_BOUND('',#30,.T.);
#24=FACE_OUTER_BOUND('',#31,.T.);
#25=FACE_OUTER_BOUND('',#32,.T.);
#26=FACE_OUTER_BOUND('',#34,.T.);
#27=EDGE_LOOP('',(#66,#67,#68,#69));
#28=EDGE_LOOP('',(#70));
#29=EDGE_LOOP('',(#71,#72));
#30=EDGE_LOOP('',(#73,#74,#75,#76));
#31=EDGE_LOOP('',(#77,#78,#79,#80,#81));
```

STEP



STL

# Takeaways

- Lessons learned:
  - How to develop, mold a research question
  - Coding experience
- Challenges faced:
  - Lack of time during June
- What went well:
  - Made new connections, met new people!
  - Getting my first paper (hopefully) accepted