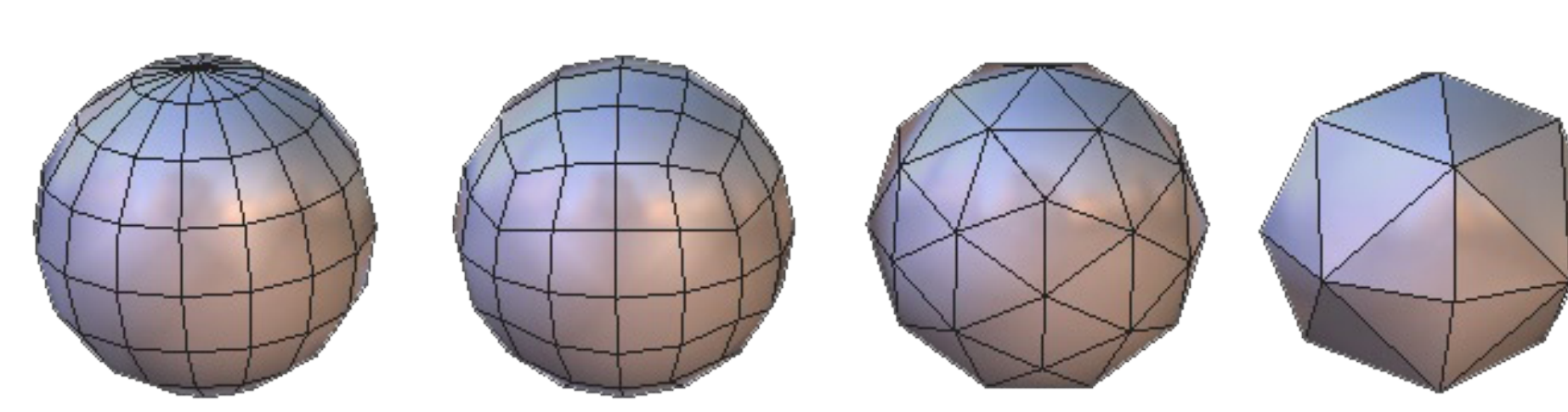# CPS: Medium: Collaborative : Frequency Domain Conversion of Computer Aided Design Files to Enable Encryption, Authentication and Feature Search Function

Nikhil Gupta (NYU), Ramesh Karri (NYU), Nektarios Georgios Tsoutsos (UD)
New York University (Award 1932264), University of Delaware (Award 1931916)

3D Design — Fourier Transform — Spectrogram — Authentication — Compression — Search

Challenges:

- Multitude of CAD formats (STL, STEP, IGES, Parasolid, …)
- Shapes consist of points and are not directly defined
- Many lossless audio compression algorithms (WavPack, FLAC)
- Many different CAD suites, use of different parameters

Intellectual Merit:

- Develop fundamental principles for converting CAD models to the frequency domain (e.g., audio formats)
- Algorithms to test robustness for lossless conversion
- Search functionality of design features in Freq. domain
- Authentication of CAD files in the Freq. domain

CAD to Sound:

- Store shape definitions near origin (low frequencies)
- Store shape characteristics at multiples of base frequency
- Represent data as sine waves of varying frequency
- For search, look up in the base frequencies

Characteristics at multiples of base frequency

Shape information in low frequencies
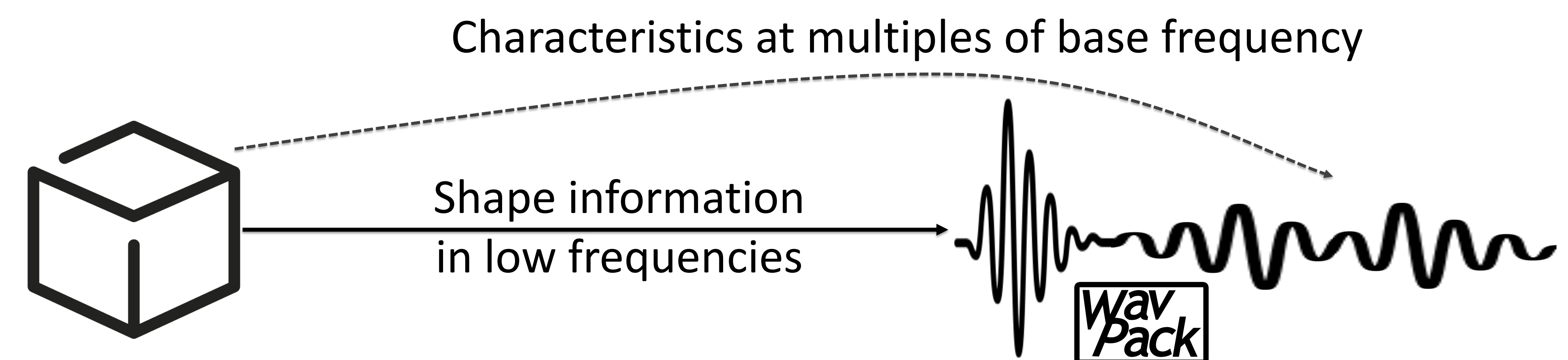
Broader Impact on Society:

- 3D printing has grown to $10B in 2019
- Impact on industries using 3D printing (aerospace, automotive, medical etc.)
- Prevent sabotage, theft of design files
- Authenticity of files in online libraries

Broader Impact (Education, Outreach):

- Development of new courses
- Undergraduate research program
- Cybersecurity awareness worldwide events (Hack3D, ESC competitions)
- Public education videos

Broader Impact Quantification:

- The PIs/co-PIs organize international cybersecurity competitions (CSAW)
- Measure ability to convert and recover CAD files to/from Freq. Domain
- Use of realistic CAD models