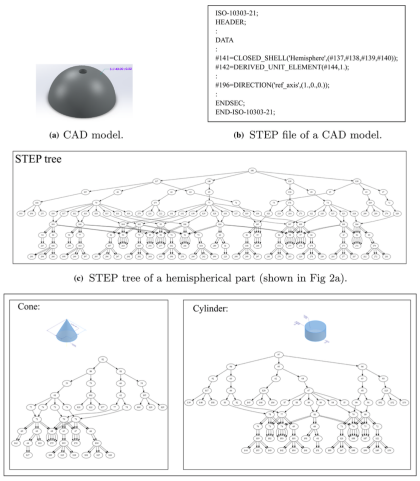
STEP File Tensor Generation

MBD captures the complete specification of a part in digital form and leverages (at least) the universal STEP file format.



(a) CAD model. (b) STEP file of a CAD model.

(c) STEP tree of a hemispherical part (shown in Fig 2a).

Category

Software

Learn more

Background

Model Based Definition (MBD) represents a comprehensive information source for achieving a smart manufacturing program; MBD can specify all requirements for the part(s). MBD in the form of ISO 10303 defined STEP ("STandard for the Exchange of Product") file standard is a widely used neutral product data format. As a file-exchange format, it is compatible with most computed aided design (CAD) software. However, a method is needed to transform the digital definitions in any given STEP file into a tensor-like structure in order to regenerate the original STEP file completely.

Description

MBD captures the complete specification of a part in digital form and leverages (at least) the universal STEP file format. MBD has revolutionized manufacturing due to time and cost savings associated with containing all engineering data within a single digital source. LLNL researchers have been able to develop a novel encoding method to transform digital definitions in any given STEP file into a tensor-like structure that is unique for each part and can be used to regenerate the original STEP file completely. Resulting STEP tensors are amenable to part comparison based on various part specifications in a general and straightforward manner.

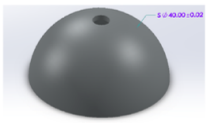
Advantages

- Time and cost savings associated with containing all engineering data (complete specification of a part) within a single digital source

- Intercomparison of parts can be used to leverage prior knowledge of manufacturing process of similar parts, which can in turn be leveraged to improve the design and manufacturing processes
- Novel approach is amenable to part intercomparison in a general manner; it is not limited to families of geometric shapes or fabrication methods; it does not require prior knowledge about parts being compared

Potential Applications

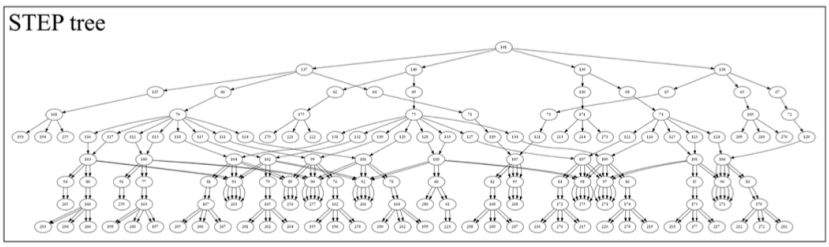
Manufacturing Automation



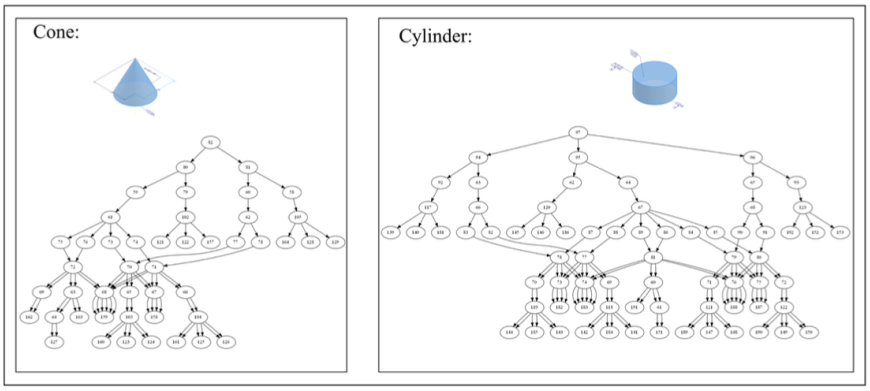
(a) CAD model.

```
ISO-10303-21;
HEADER;
:
DATA
:
#141=CLOSED_SHELL('Hemisphere',(#137,#138,#139,#140));
#142=DERIVED_UNIT_ELEMENT(#144,1.);
:
#196=DIRECTION('ref_axis',(1.,0.,0.));
:
ENDSEC;
END-ISO-10303-21;
```

(b) STEP file of a CAD model.



(c) STEP tree of a hemispherical part (shown in Fig 2a).



References

1. Ojal, N., Giera, B., Devlugt, K.T. et al.(2022) , A universal method to compare parts from STEP files, https://doi.org/10.1007/s10845-022-01984-3, 33, 2167-2178