Smart Space Subdivision of Polyhedral Models for Indoor Navigation (SIMs3D)

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IndoorLab

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- Type of input formats
- Extraction of free space
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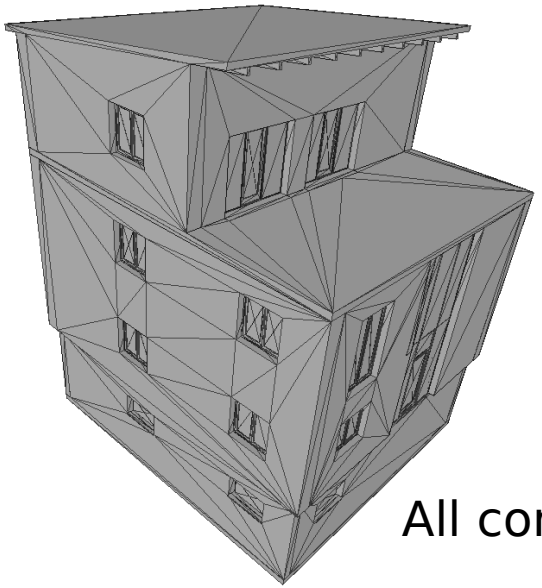
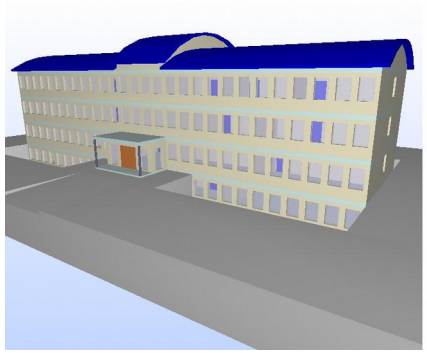
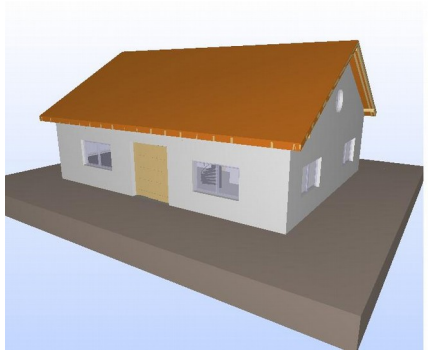
Relevant information

- Polyhedral (vector) models





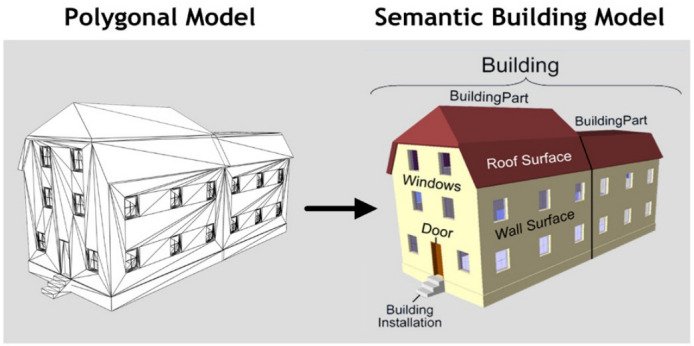


Source: Open IFC Model Repository

All components of the building correspond to closed volumes.

Relevant information

- 3D Spaces!
- Semantic
  - Type/nature of the components in the model.
  - Materials, properties, etc.

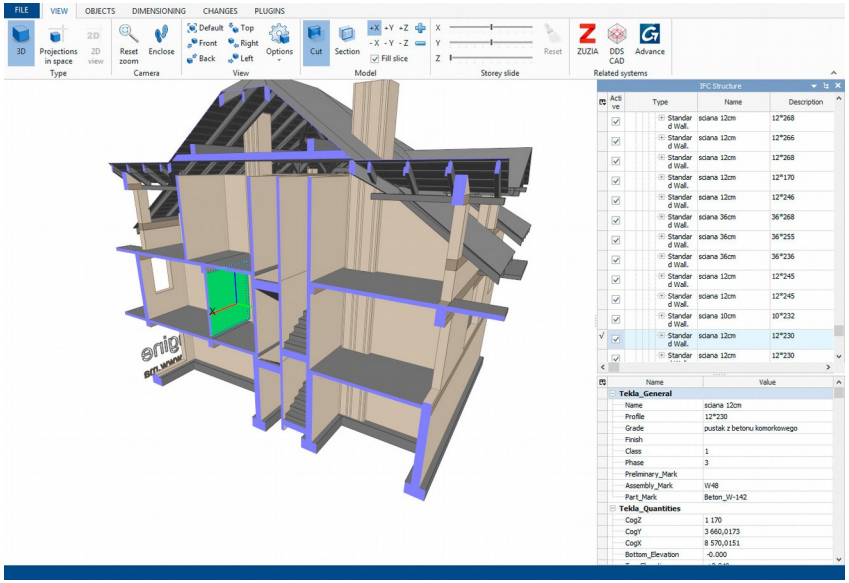


Source: Nagel et al. 2009

- Topology
  - Spatial relationships between the components

Type of Input Formats

- BIM models:
  - IFC, CityGML LoD4, etc.

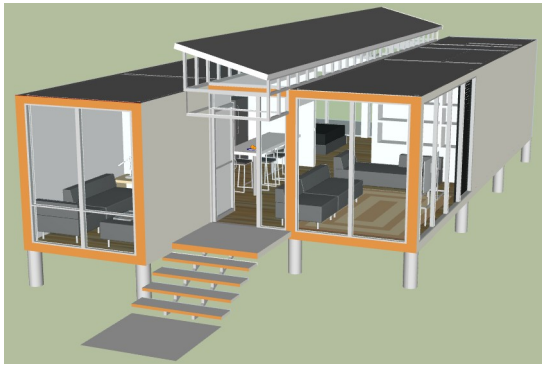


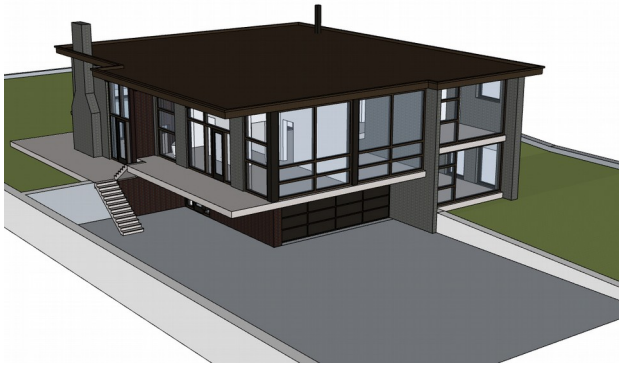
Source: BimVision

  - Pros/Cons: Rich in information (geometry, semantic and topology), but complex structure and hard to handle/parse.

Type of Input Formats

- Geometric models:
  - CAD, Collada, OBJ, SKP, etc.





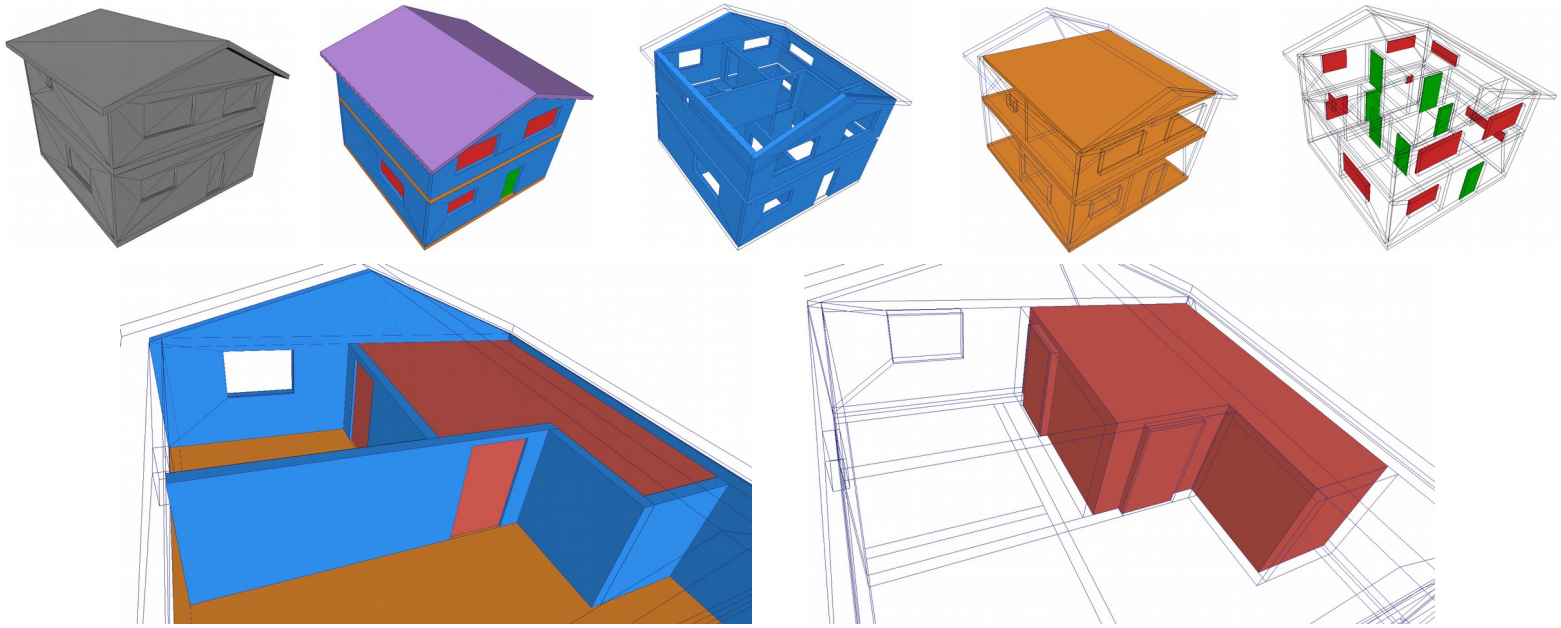
Source: SketchUp 3D Warehouse

  - Pros/Cons: Easy to handle but poor in information (just the geometry).

We want the indoor spaces!!!

Type of Input Formats

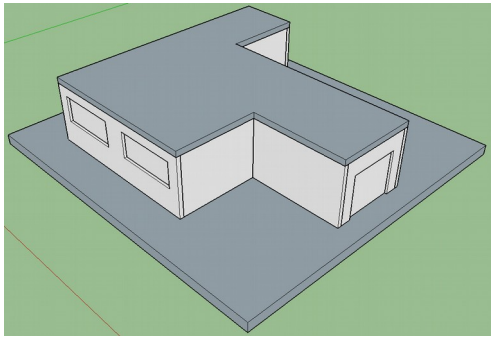
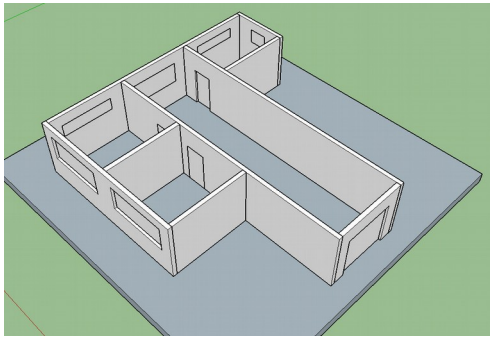
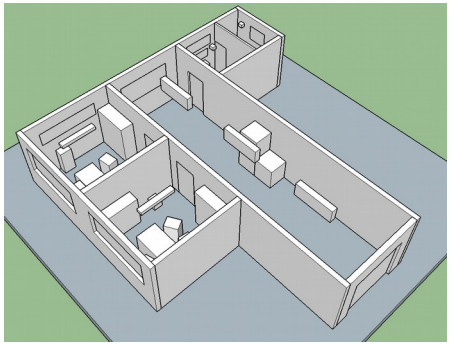
- Geometric models:
  - CAD, Collada, OBJ, SKP, etc.
  - Possibility to enrich with topology and semantic from geometry.



Source: Diakité et al. 2014

Extraction of Free Space

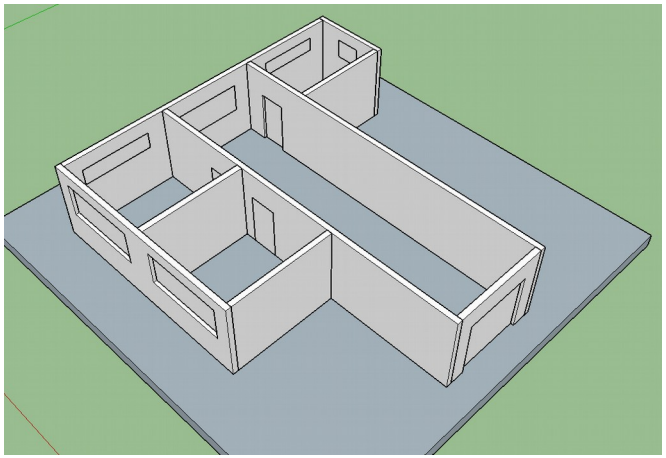
- Automatically extracted based after topological reconstruction

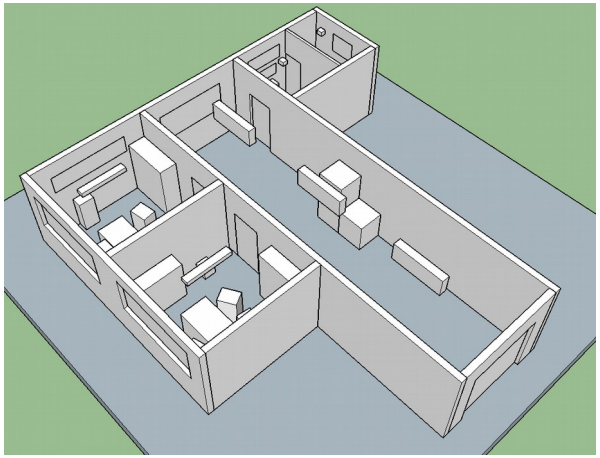




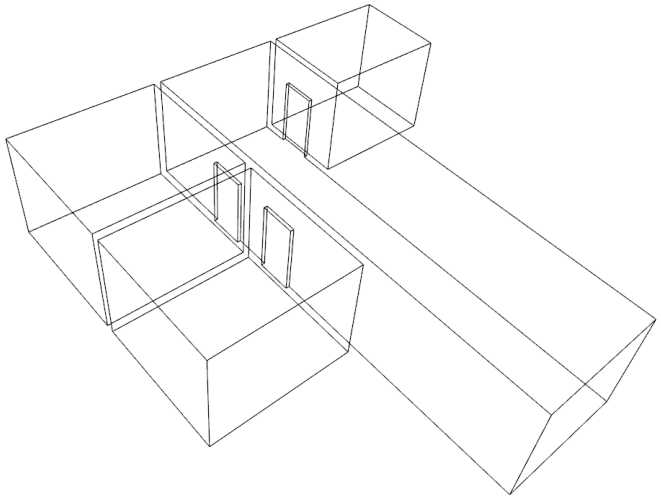
Demo!

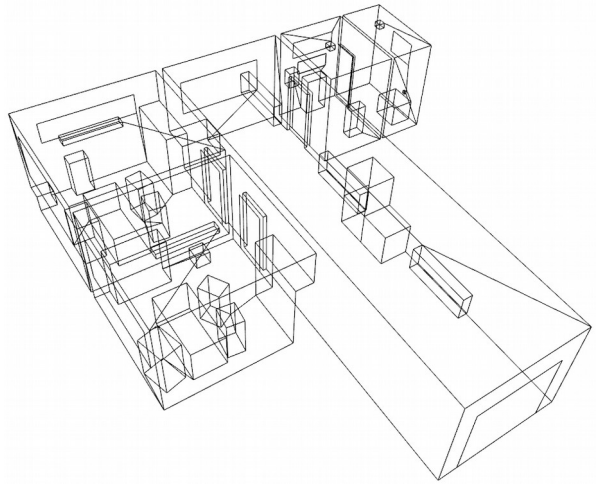
Extraction of Free Space

- Simple/Complex volumes representing the free space



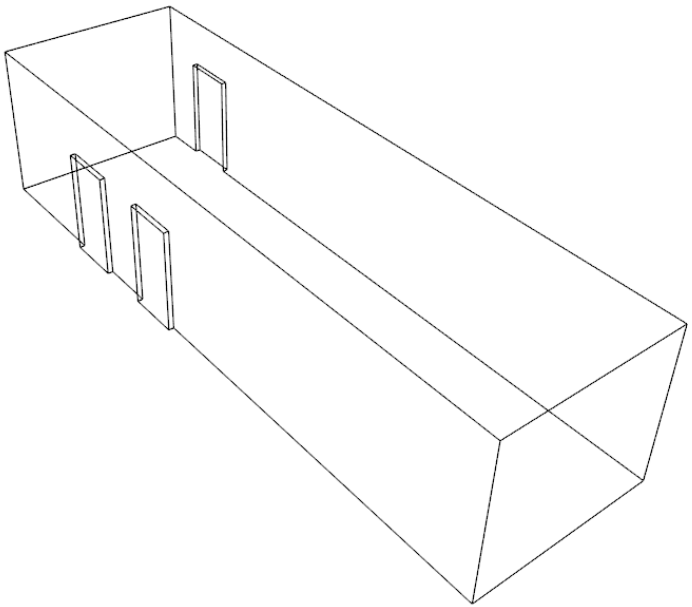


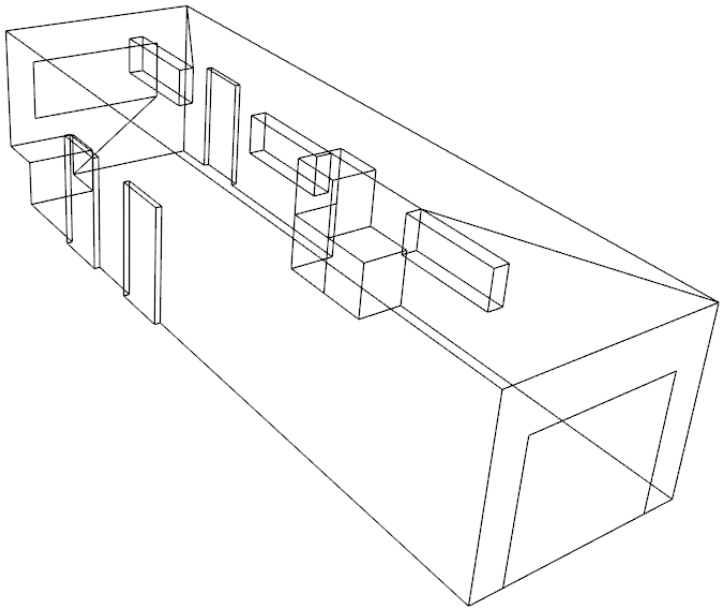




Possible Subdivision Approaches

- Which type of indoor space are more appropriate?

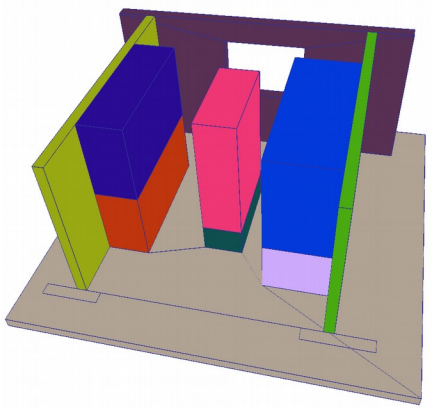


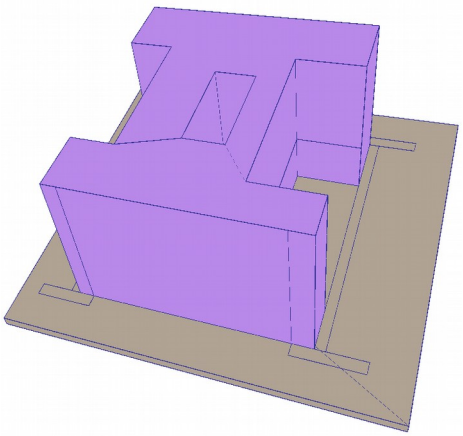


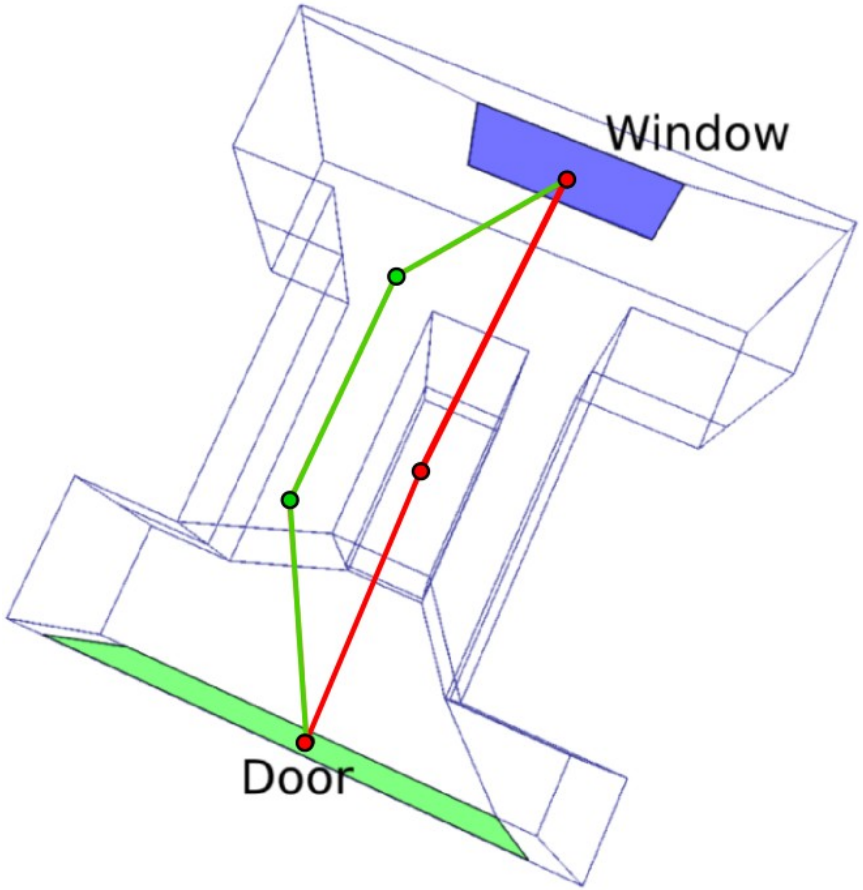
- Now what to do with such volumes?

Possible Subdivision Approaches

- Not suitable, as they are, for navigation!

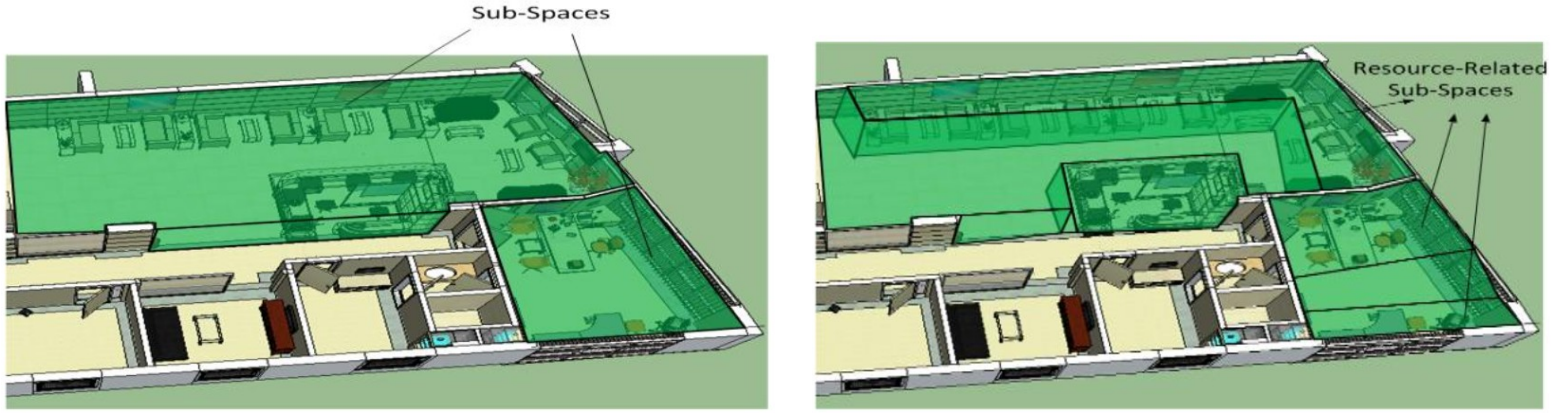






Possible Subdivision Approaches

- Develop a subdivision scheme based on surrounding information.
  - Spaces smart subdivision for usage of the space.

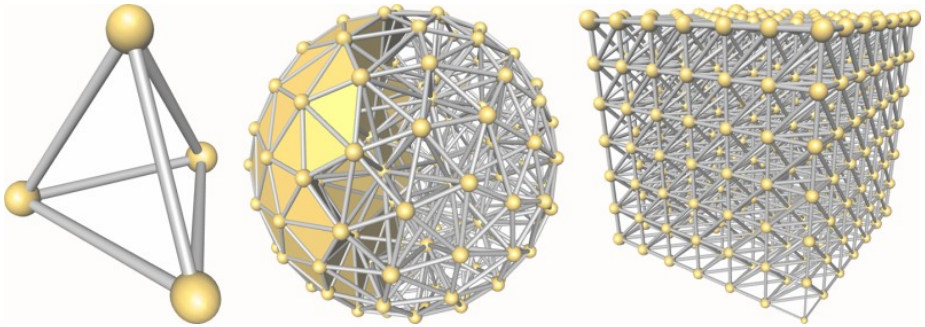


Source: Zlatanova et al. 2013

  - Smart subdivision for navigation path extraction.

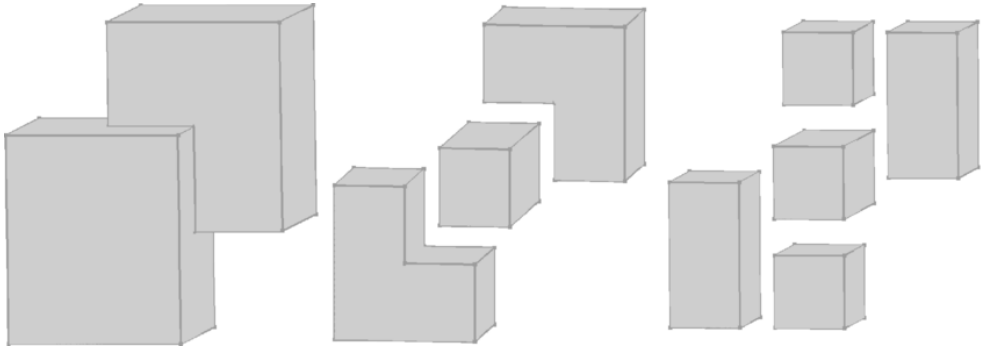
Possible Subdivision Approaches

- Tetrahedralization?
  - Insure convex subspaces.
  - May generate complex paths.



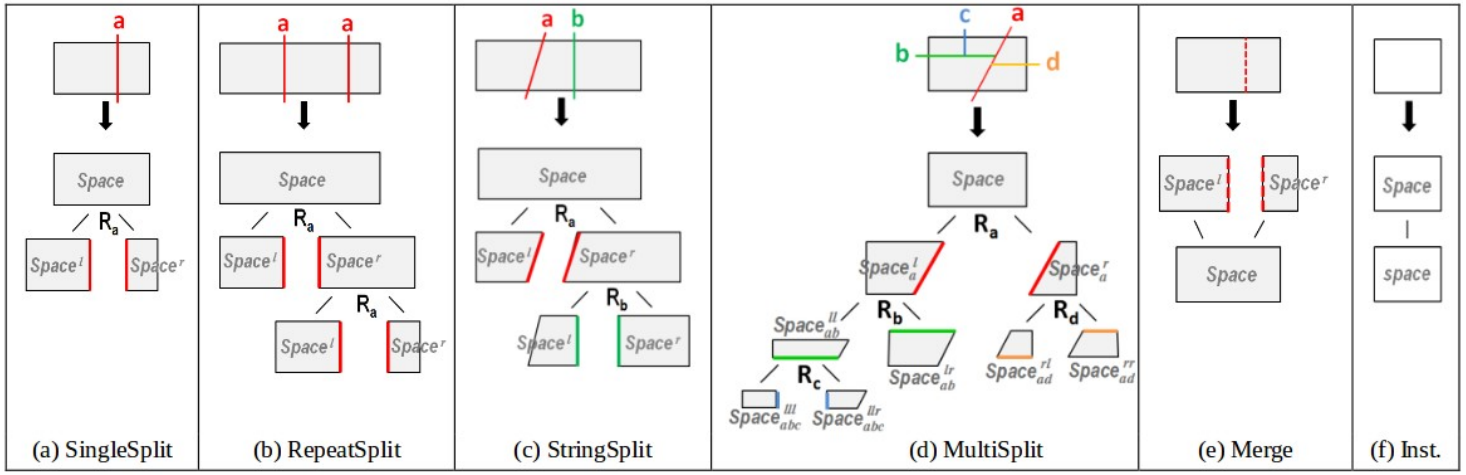
- Convex Decomposition?

Images source: CGAL



Possible Subdivision Approaches

- Grammar based subdivision?
  - Set of rules/operations to generate spaces



Source: Becker et al. 2013

Most of the approaches require boolean operations!
Costly and sensitive to precision issues…

Possible Subdivision Approaches

If you have better ideas…?

References

- Becker, S., Peter, M., Fritsch, D., Philipp, D., Baier, P., & Dibak, C. (2013). Combined grammar for the modeling of building interiors. Proceedings of the ISPRS Acquisition and Modelling of Indoor and Enclosed Environments.

- Diakité, A. A., Damiand, G., & Gesquiere, G. (2014, November). Automatic Semantic Labelling of 3D Buildings Based on Geometric and Topological Information. In Proc. of 9th International 3DGeoInfo Conference (3DGeoInfo). Karlsruhe Institute of Technology.

- Nagel, C., Stadler, A., & Kolbe, T. H. (2009). Conceptual requirements for the automatic reconstruction of building information models from uninterpreted 3D models. Proceedings of the International Archives of Photogrammetry, Remote Sensing and Spatial Information Sciences, 46-53.

- Zlatanova, S., Liu, L., & Sithole, G. (2013, November). A conceptual framework of space subdivision for indoor navigation. In Proceedings of the Fifth ACM SIGSPATIAL International Workshop on Indoor Spatial Awareness (pp. 37-41). ACM.