MSc Project Proposal Form

Project organization				
Company	KUBUS			
Depart-ment	Development			
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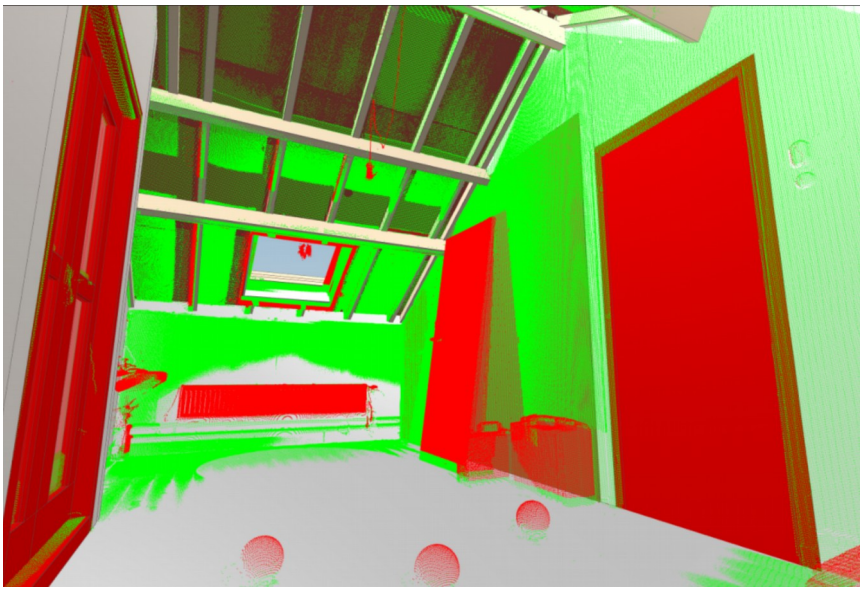
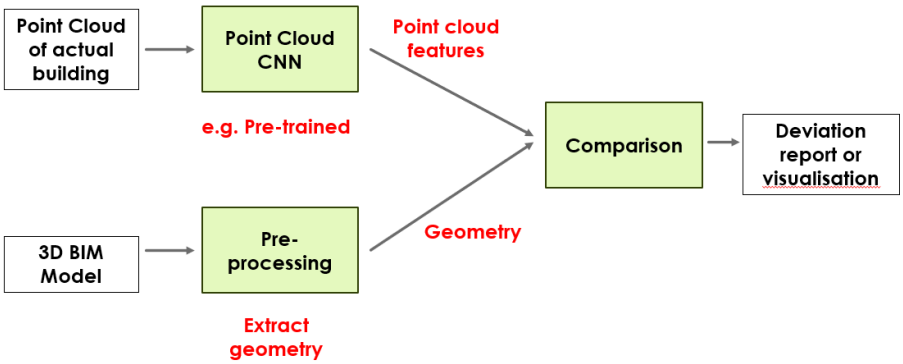
Project contents				
Title	**Deep Learning and AI for LIDAR vs IFC consistency in BIM analysis**			
Context	With BIMcollab, KUBUS is the global market leader in cloud-based BIM issue management, integrated with model validation. In addition, KUBUS is the exclusive distributor of Archicad in the Netherlands and Flanders and developer of the most widely used builders estimate processor in the Netherlands, KUBUS Spexx. KUBUS has been supplying BIM software for design and construction since 1992: from design software to tools for model checking and issue management for improving model quality. KUBUS also advises and supports companies in the transition to working with BIM, where the practice-oriented approach is experienced as distinctive. The objective of this project is to create and extend tools to introduce AI into the BIM software domain.			
Descrip-tion	Building Information Modelling (BIM) or Building Information Management, is a highly collaborative process that allows architects, engineers, real estate developers, contractors, manufacturers, and other construction professionals to plan, design, and construct a structure or building within one 3D model. During the building phase it is highly desired to compare the actual (real) con-struction details with the 3D BIM design. For this purpose a LIDAR scan records 3D point clouds of the real situation, where engineers are interested in deviations from LIDAR and BIM. Comparison tools can show deviations be-tween point cloud and 3D model. Such a tool enables visualization of deviations between scanned points and the model, with user-desired tolerances.			

	 *Example of a 3D model of a house, with a colored point cloud scan overlayed. Points from the cloud matching the model are green, points mismatching are red. Notice the door missing from its place in the 3D model, and instead resting against the wall. Also notice that many details are not modelled, like the light bulb hanging from the ceiling, the radiator against the far wall, and various construction items that are only temporarily present.*
Goals	Modern AI and Deep Learning is capable of detecting specific objects in complex structures, like 3D geometry and/or point cloud data. It is expected that neural networks are able distinguish objects in point clouds and compare them to the BIM design. A rough layout of such a network could be



Visual inspection it is often intuitively clear which individual points are members of a group, and may be wrong (not belonging to the model), irrelevant or correct. The BIM application user wants to communicate possible actions for a specific object or group of objects.

A possible outcome of an AI network could be the detection of object groups, e.g. with object boxes and labels.

Challenges

Design and evaluate DL algorithms (BIM AI) for LIDAR versus IFC compatibility. Set up test tooling for the used algorithms.

- Select and process actual point cloud data and corresponding BIM models
- Neural network design and implementation for measuring deviations between selected point cloud data and BIM
- Train and test the neural network
- Assist in evaluating a possible demonstrator at KUBUS site
- Reports and presentation of the results to KUBUS and university audience

Project period

2023/2024

Required skills

- Experience in software development, preferably fluency in Python and C++
- Good experience with AI frameworks for DL, like Tensorflow or Pytorch
- Good experience with various aspects of Computer Graphics (scene graphs, meshes, point clouds, compression techniques)
- Experience with deep learning on point clouds
- Good communication and reporting skills are essential in the Architecture, Construction and Engineering domain. Fluency in English or Dutch is required.

Relevant references

[1] LIDAR versus BIM, Integrating_BIM_and_LiDAR_for_Real-Time_Construction_Quality_Con-

trol.pdf ,
https://link.springer.com/article/10.1007/s10846-014-0116-8

[2] How to compare differences between BIM model and point cloud data

[3] Comparative visualisation of BIM geometry and corresponding point clouds.pdf

[4] Understanding-machine-learning-on-point-clouds-through-pointnet

[5] Deep Learning for 3D Point Clouds: A Survey

[6] Example: Point Cloud Analysis in Autodesk Revit using the Point Layout add in