IBPSA Project 1

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Task 2: Building and City Quarter Models
WP 2.2: Building Information Modeling

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Eric Fichter

Quick reminder: goals

Content	Method	Result
▪ **Space boundary** algorithms for model topology analysis and multi-scale simulation model generation ▪ **Update exchange** with Energy Plus	▪ **Review** of existing approaches, algorithms, codes and model checkers ▪ Evaluation of **best-in-class algorithms** for model-garbage analysis and processing ▪ Decision on **development path** and code re-use ▪ Development of **modular tools** for space boundary and model topology analysis	▪ Joint journal **publication** / review paper ▪ **GIT repository** with modular tools

Issues

- **Collection of issues (todos) and their state of execution on git repository**

Task	Description	Team
Wiki for Tools	Installation and setup process, Version management	Eric, ChristophN.
Git repository	Base code for tools	Eric, ChristophN., Jiauri, Christian
Database/repository of test cases	Installing KIT IFC server tool on E3D server, Definition of a table of attributes for: Model quality, Instantiated variants of object types (e.g., windows, type of geometry representation), Errors & problems associated with objects	Karl-Heinz, James, Jérôme
Information Delivery Process	Definition of information delivery process (from input over algorithm to output), Definition of data drops & links, Preparing publication	Eric, ChristophV.T., Georgios, Christian
Geometric problems	Identification of geometric problems, Collecting geometric problems until second half of November, Telefonce meeting (invitation via Doodle by Eric)	All
Space boundary algorithms	Review and preparation for publication, Transformation of implemented code from institutes to task tool chain (SBT, CBIP, ...), Problematic of exportation of 2nd level space boundaries from Revit, etc.	All
MVD for BPS	To be continued at next meeting, Input by Petra v. Both (KIT), Goal: Collect simulation relevant information and eventually development of "BPS-MVD"	James, Georgios, Vlado, PetraV.Both
IFC schema	Check possibility to switch between IFC2x3 and IFC4 in IfcOpenShell, IFC wrapper for IFC2x3<->IFC4 existing?, Definition of used format	David
HVAC modeling	Create list of missing IFC entities or property sets and push them into committees, Schema to use for generic description, Pressure on vendors, Hold in mind different LOD for simulations	Moritz, David

Current status

Git repository

- Repository for organization:

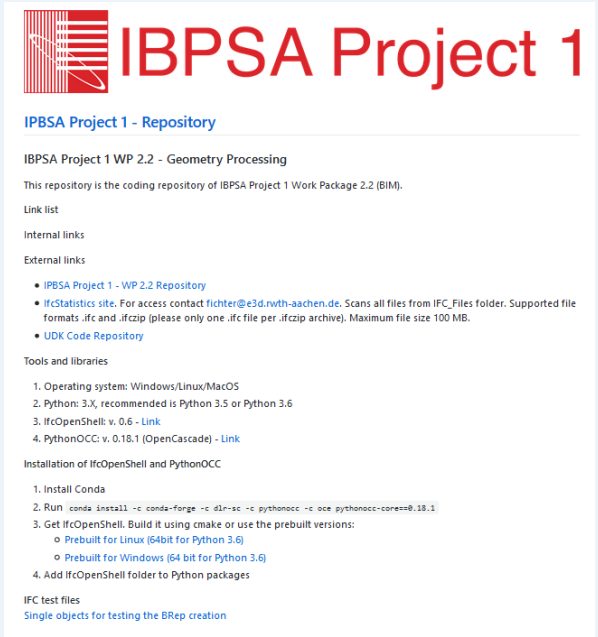
  https://github.com/ibpsa/project1/tree/master/wp_2_2_bim

  - To-do
  - BPMN schema
  - …

- Repository for code:

  https://github.com/ibpsa/project1-wp-2-2-bim

  - Base code
  - Links
  - IfcStatistics
  - …



Current status

Wiki for Tools

- Can be found in the coding repository: https://github.com/ibpsa/project1-wp-2-2-bim
- Content:
  - Links for library download
  - Installation manual
  - Link to brep test files
- Currently, easy setup of work station
- Open interfaces for additional libraries/tools

Current status

Base Code

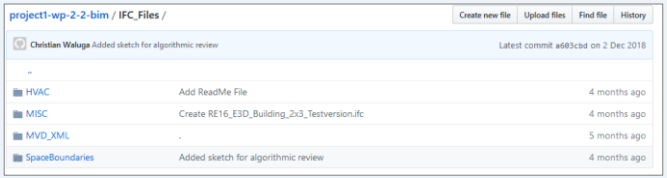
- Base code works for IFC 2x3 and IFC4
- Example code for Brep creation from IFC file
- Example code for parsing IFC file
- Link to UDK Code Repository with SBT Test Cases and advanced parsing functions
- With this base code the processes *IFC to Brep* and *IFC to Information* can be done easily
- Remaining challenges are geometrical problems

```
import ifcopenshell.geom

def product_to_shape(products,settings):
    product_shapes = []
    for product in products:
        if product.is_a("IfcOpeningElement") or product.is_a("IfcSite") or product.is_a("IfcAnnotation"): continue
        if product.Representation is not None:
            try:
                shape = ifcopenshell.geom.create_shape(settings, product).geometry
                product_shapes.append(shape)
            except:
                print(ifcopenshell.get_log)
    return product_shapes

def visualize_products(shapes):

    if isinstance(shapes, list):
        for shape in shapes:
            ifcopenshell.geom.utils.display_shape(shape)
    else:
        ifcopenshell.geom.utils.display_shape(shapes)
```

Current status

Database

- IfcStatistics by KIT can be found in repository
- Scans all files in the git IFC_Files folder
- IFC_Files: Files sorted by topic (SpaceBoundaries, HVAC …)



IFC Statistics Last Run: Montag, 1. April 2019

Home

Scanned File Systems

How many files have been scanned?

File System Name	Number of Files
C:\	85

View the Files

Entity Types

How many Entity Types have been found in the scanned files?

Entity Type	Value	Entities	Occurrences
IFC Entities	1	245	82
IFC Errors	2	19	79
Ecco Errors	3	6	31

Header Properties

How many files have header properties?

Header Field	Occurrences
Filename	82
CheckOption	82
FileDescription	638
SpfCreationDate	82
OriginatingSystem	82
ReportCreationDate	82
MVDVersionNumber	82
ViewDefinition	167
Schema	82

Session Data

How many Sessions have been performed?

Session Count	Last Session
1673	01.04.2019 15:30:04

Show the sessions

Show the last session

Scanning Errors

How many files could not be scanned or caused errors during scanning?

Error Count
3

Show the errors

External Links

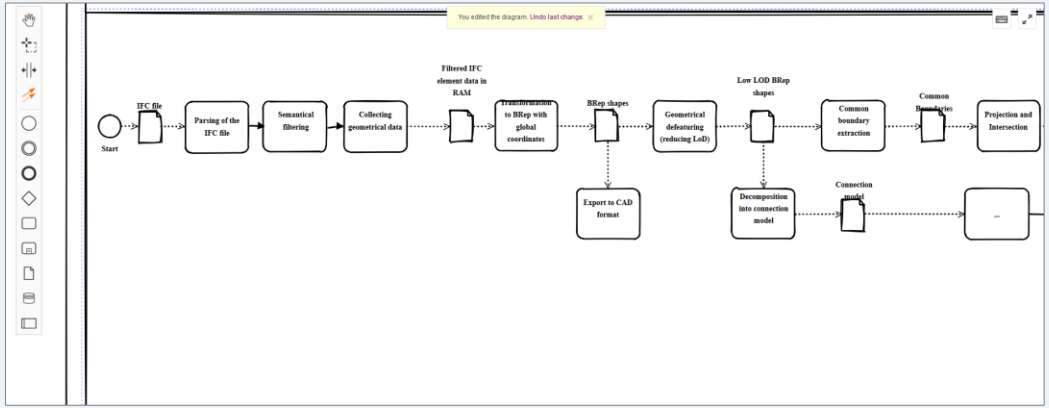
IFC 2x3 Documentation Online

IFC 4 Documentation Online

Current status

Process chart

- Intepretation of the 2.2 task as chain of processes
- Definition of the processes in repository as bpmn schema, that everybody can edit



Current status

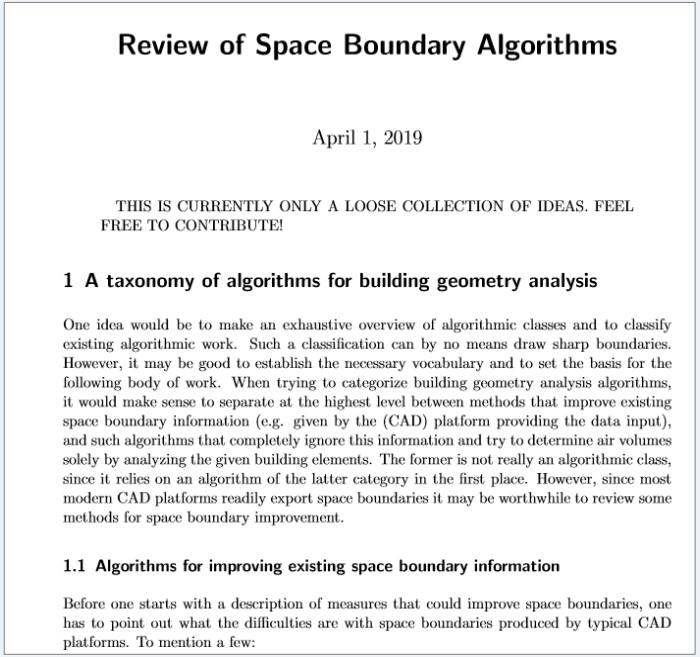
Geometric problems

- Last telephone meeting (november): „A detailed structuring of the geometric problems will be discussed during a workshop at the 3rd expert meeting”
- Proposal by KIT

Current status

Space Boundary Algorithms

- Initial document by Christian Waluga (liNear) in repository



Review of Space Boundary Algorithms

April 1, 2019

THIS IS CURRENTLY ONLY A LOOSE COLLECTION OF IDEAS. FEEL FREE TO CONTRIBUTE!

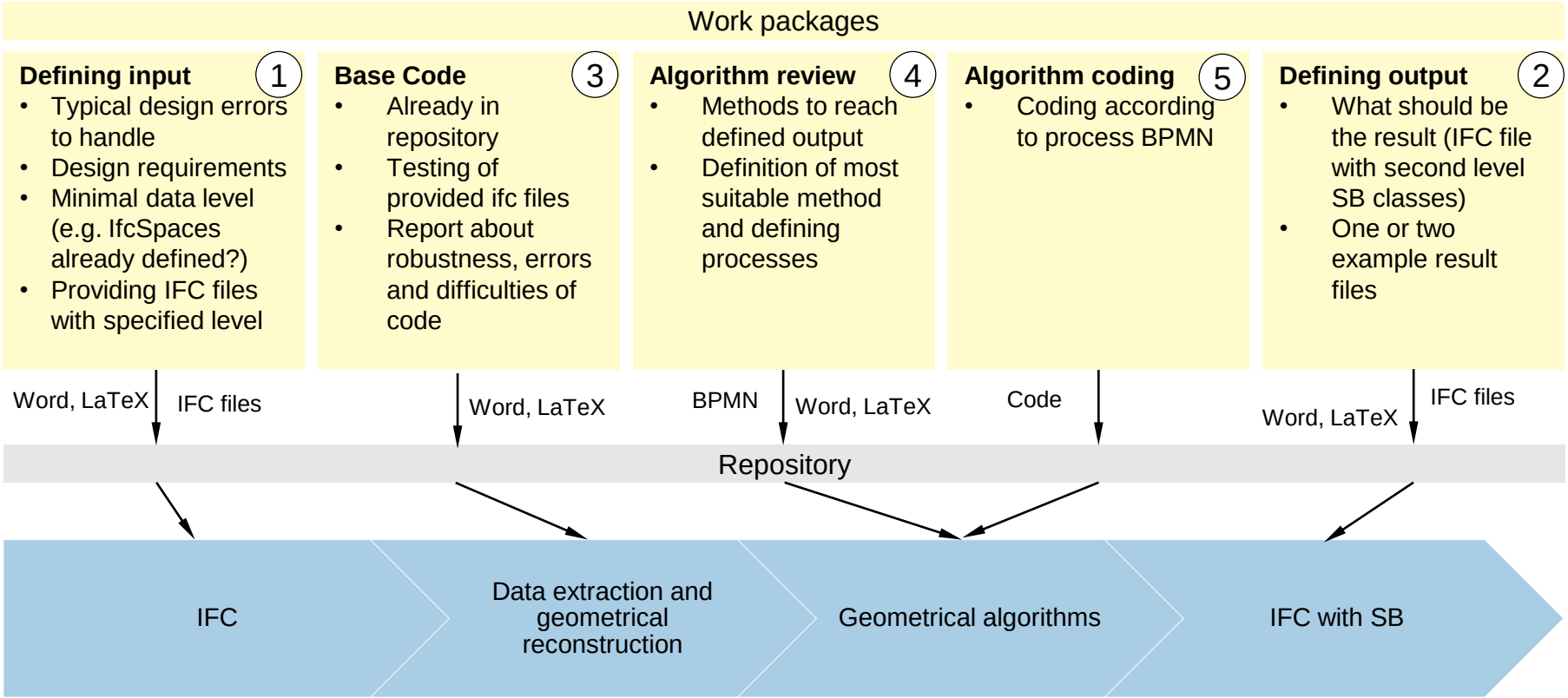
1 A taxonomy of algorithms for building geometry analysis

One idea would be to make an exhaustive overview of algorithmic classes and to classify existing algorithmic work. Such a classification can by no means draw sharp boundaries. However, it may be good to establish the necessary vocabulary and to set the basis for the following body of work. When trying to categorize building geometry analysis algorithms, it would make sense to separate at the highest level between methods that improve existing space boundary information (e.g. given by the (CAD) platform providing the data input), and such algorithms that completely ignore this information and try to determine air volumes solely by analyzing the given building elements. The former is not really an algorithmic class, since it relies on an algorithm of the latter category in the first place. However, since most modern CAD platforms readily export space boundaries it may be worthwhile to review some methods for space boundary improvement.

1.1 Algorithms for improving existing space boundary information

Before one starts with a description of measures that could improve space boundaries, one has to point out what the difficulties are with space boundaries produced by typical CAD platforms. To mention a few:

Overview I


Work packages
Defining input
1
• Typical design errors to handle
• Design requirements
• Minimal data level (e.g. IfcSpaces already defined?)
• Providing IFC files with specified level
Base Code
3
• Already in repository
• Testing of provided ifc files
• Report about robustness, errors and difficulties of code
Algorithm review
4
• Methods to reach defined output
• Definition of most suitable method and defining processes
Algorithm coding
5
• Coding according to process BPMN
Defining output
2
• What should be the result (IFC file with second level SB classes)
• One or two example result files
Word, LaTeX
IFC files
Word, LaTeX
BPMN
Word, LaTeX
Code
Word, LaTeX
IFC files
Repository
IFC
Data extraction and geometrical reconstruction
Geometrical algorithms
IFC with SB

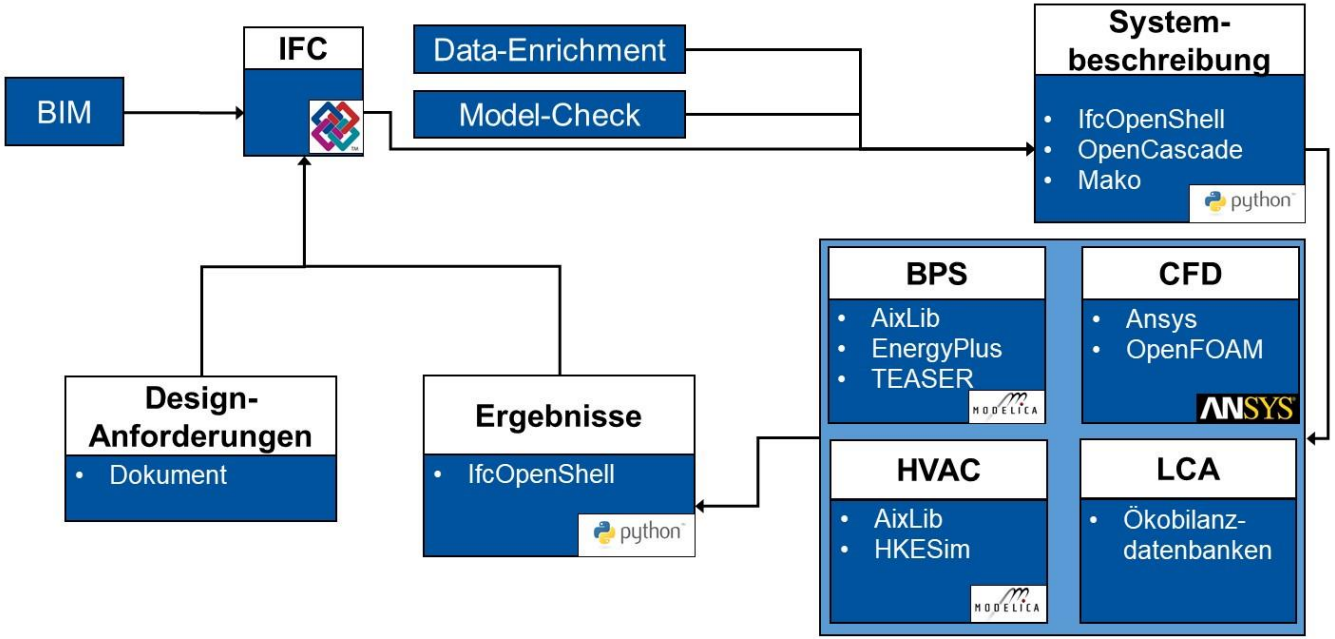
Overview II

Work packages

Model View Definition
- Coordination in this meeting

HVAC modeling
Done:
- Analyzing IFC HVAC objects
- Creating graph of HVAC system
- Functions to identification of HVAC subsystems

BIM2SIM



To be continued in break-out groups …