Course introduction

GEO1004:
3D modelling of the built environment

https://3d.bk.tudelft.nl/courses/geo1004

3D geoinformation
Department of Urbanism
Faculty of Architecture and the Built Environment
Delft University of Technology

Ken Arroyo Ohori

Hugo Ledoux

Ravi Peters

guest
lecture

And you?

Name, experience and interest in 3D modelling

Course contents

- How is the built environment modelled in 3D?
  - Fundamentals / concepts
  - Data models and data structures
  - Guest lecture: reconstructing a city in LoD2
  - Applications

New-ish course

- Continuous improvements
  - 2020: Entirely new contents
  - 2022: 3D book
  - 2024: More info: Minkowski sum, new lesson
- Feedback is appreciated!

Prerequisites

- GEO1000 or knowledge of scripting/programming (in any language)
- GEO1002 or basic knowledge of (2D) GIS

- Optional: GEO1015 (Q2) covers complementary topics (2.5D vs 3D)

Blended learning

In your own time:

1. Watch videos
2. Read materials
3. Most important: work on assignments

Contact hours?

- Per week: 2x2h during Monday & Wednesday labs (13:45)
- At the beginning: short lectures, introduction to course/assignments, discussions and demos of course topics, feedback on assignments/exams, etc.
- Then: answer questions, discuss common issues, help with assignments, general programming questions, etc.
- At other times, you can still ask questions on Discord. We might just take longer to answer.

Extra help sessions

Dimitris Mantas

student
assistant

Help with C++ setup and assignments

Thursdays 16:00 - 17:30

Geolab

How to make the most of it

1. Keep up with the course schedule
2. Study (or at least skim) lessons in advance
3. If you have any doubts, ask questions
4. Make sure you can answer questions (at the end of book chapters)
5. Optional: read one or two external sources (in notes in each chapter)
6. Spend more time on assignments than on lessons

Lessons

- 1.1: Intro [K]
- 1.2: B-rep [K]
- 2.1: 3D DT / Voronoi [H]
- 2.2: Voxels [K]
- 3.1: ISO 19107 [H]
- 3.2: 3D city models [H]
- 4.1: MAT [K]
- 4.2: LoD2 reconstruction [R]
- 5.1: G-maps / c-maps [K]
- 5.2: Curves [K]
- 6.1: CSG [K]
- 6.2: BIM [K]
- 7.1: TBD [K]
- 7.2: Applications [K]

Assignments

- Programming tasks using C++ and open source libraries
- 10% hw1, 20% hw2 and hw3

- 0: C++ preparation (no deadline / not marked)
- 1: Triangulating polyhedron faces (Mar 1) -> available from Wednesday
- 2: Generalising a 3D city model (Mar 22) -> available in week 3
- 3: BIM processing (Apr 12) -> available in week 6

Two exams (in person)

- Mid-term
  - Lessons 1.1 - 4.1
  - Mar 13
  - 5% of final mark
- Final
  - All lessons
  - Apr 12 @ 9:00
  - 45% of final mark

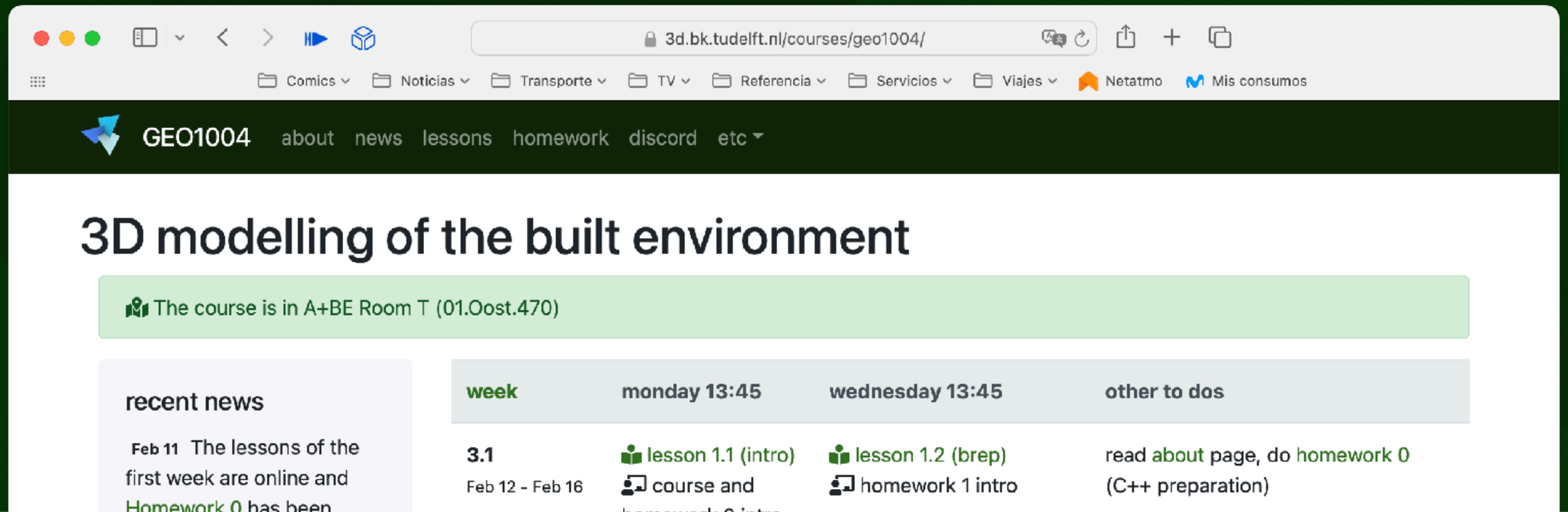
- Weighted average of 50% to pass the course

Resits

- One resit for both exams together (50%)
- One resit per assignment (mostly likely redo of assignment with modified tasks)
- June 28 @ 9:00

Course website

- No Brightspace!
- Everything is here: https://3d.bk.tudelft.nl/courses/geo1004/
- On Monday: check announcements/timetable



Questions?

- In person during contact hours or Discord anytime:

- Don’t hesitate to ask! General software/programming questions are fine too
- If possible, use geo1004 channel -> everyone can benefit from answers
- E-mail or Discord DM for personal matters

Introduction to 3D modelling of the built environment

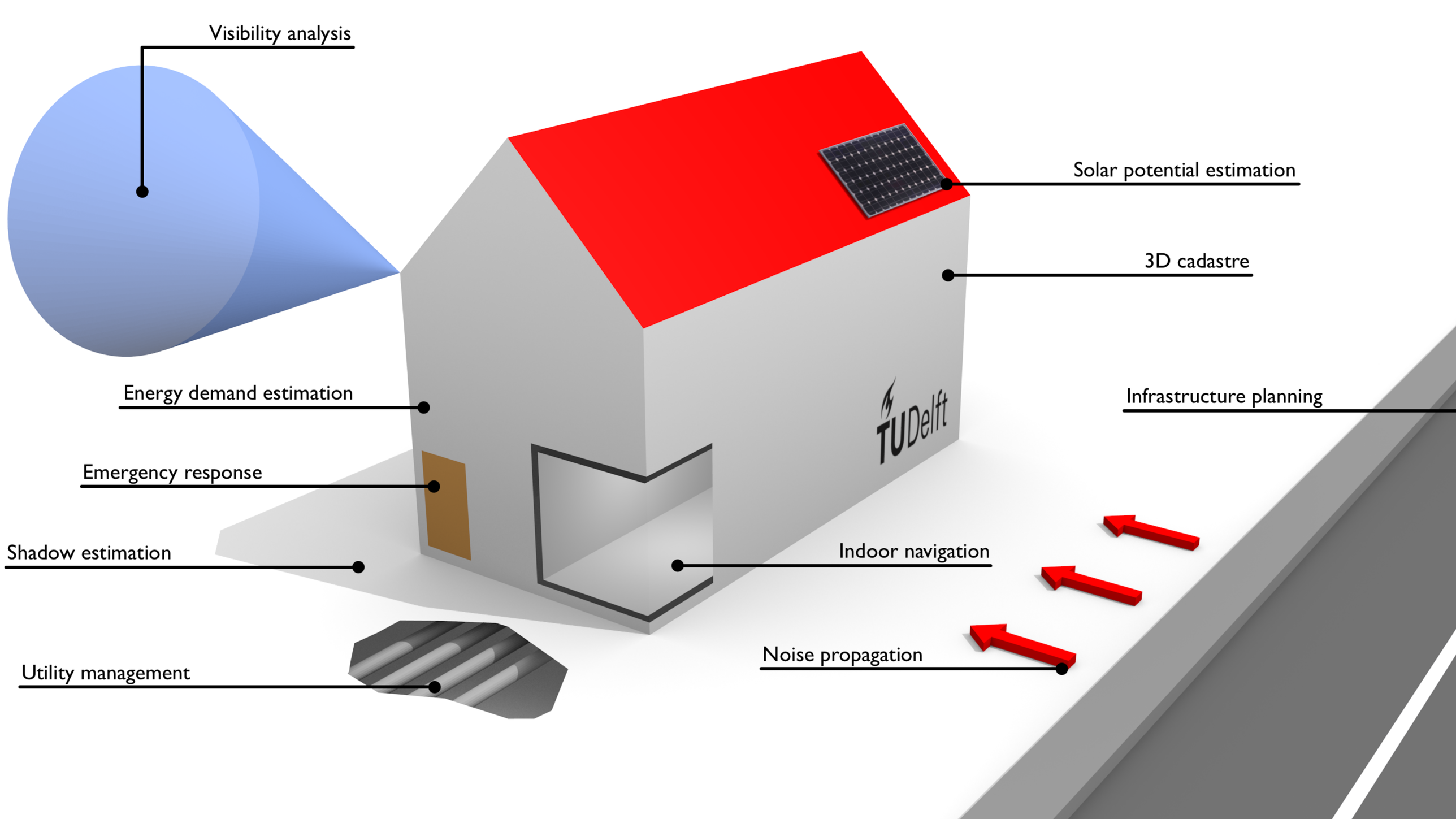
Introduction to 3D modelling of the built environment

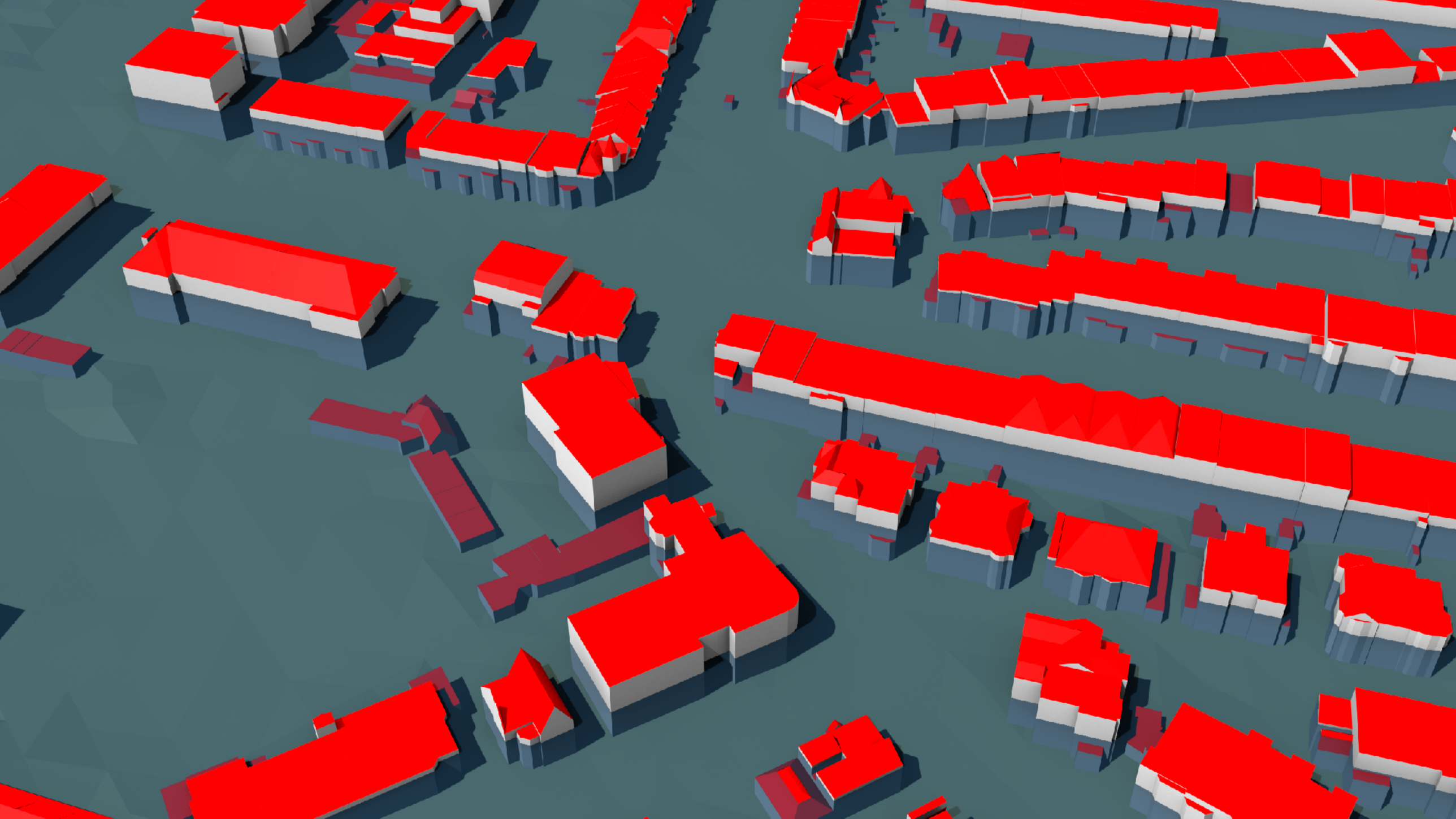
3D modelling of the built environment

- creation of 3D representations
- ...of anything, real world or not
- ...for animation, films, video games, industrial design, etc.

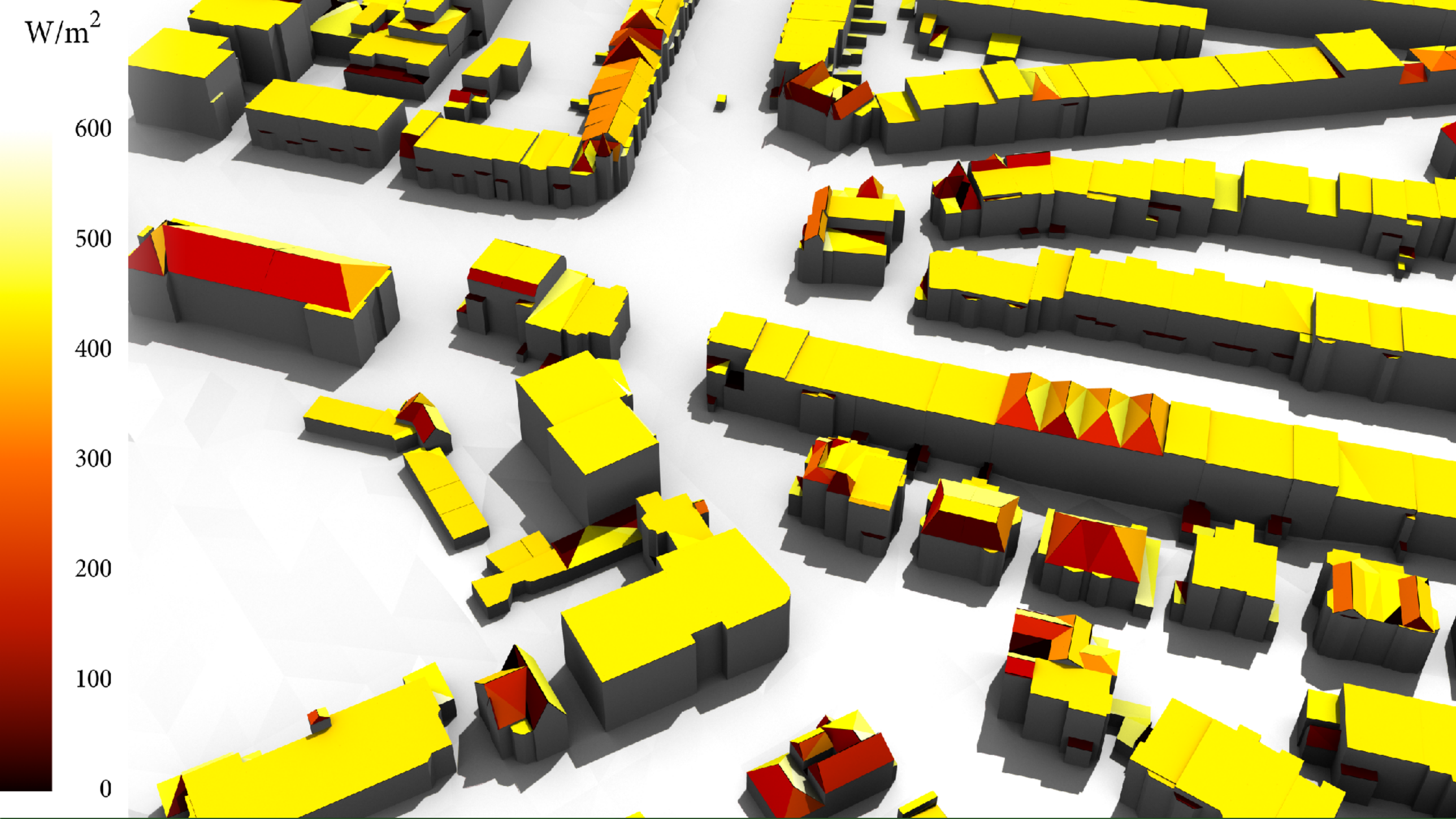
- focus on representations and techniques that are useful
- ...for real-world objects and fields
- ...in applications within geomatics and related fields

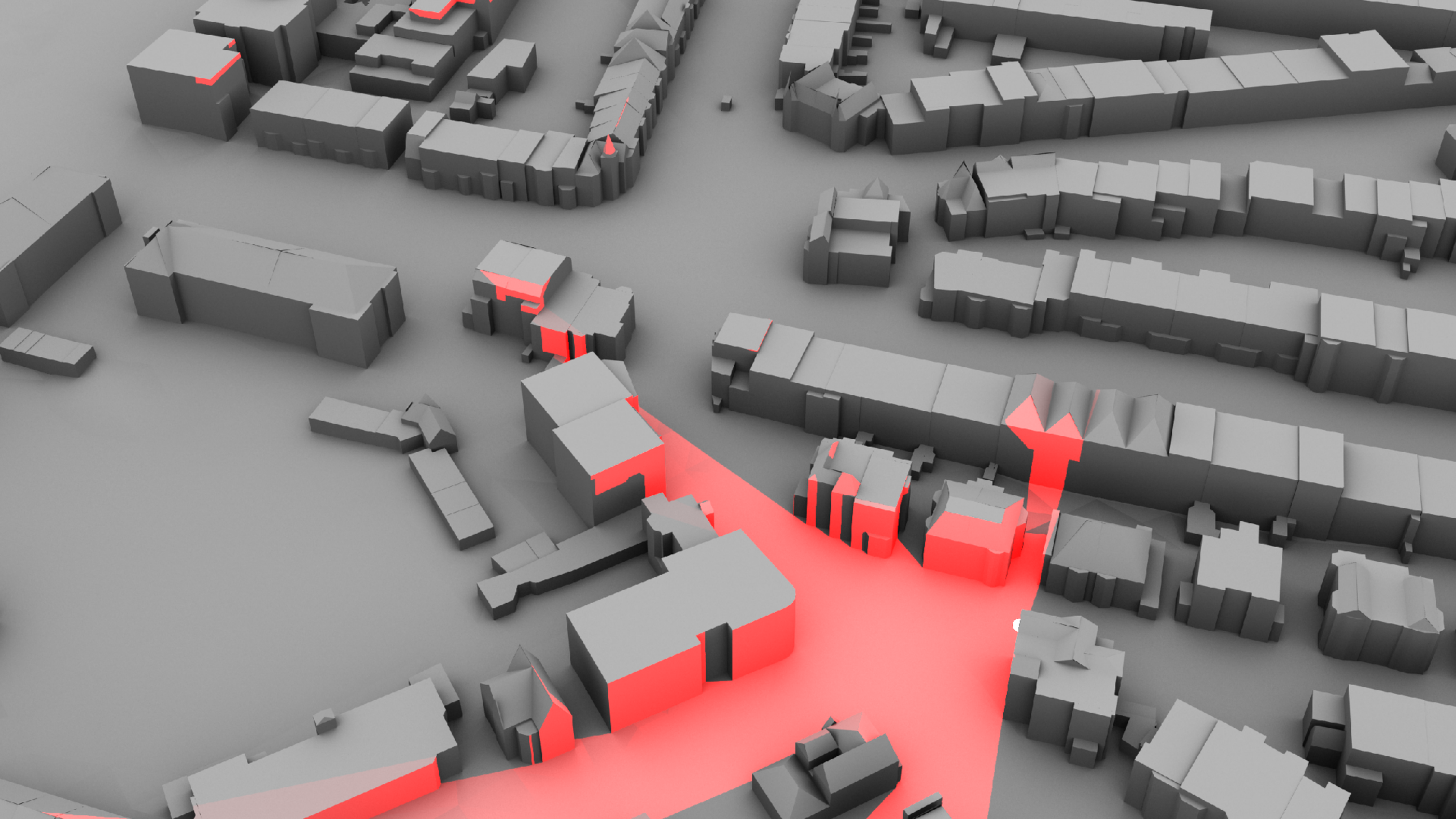
Why 3D?


Visibility analysis
Solar potential estimation
3D cadastre
Energy demand estimation
Infrastructure planning
Emergency response
Shadow estimation
Indoor navigation
Noise propagation
Utility management
TUDelft



dB
60
45
30


W/m2
600
500
400
300
200
100
0



Other applications

- Visualisation (eg for gaming, tourism, navigation, etc)
- Energy demand estimation (and potential for retrofitting)
- Computational fluid dynamics (eg for wind speeds, air quality, effects on buildings, etc)
- Shadow casting (eg for building permits, visibility analysis, improving energy demand/ solar potential calculations, etc)

Homework 0 intro

Lesson 1.1 (intro)

- More of a glossary than a lesson. Read to know some important concepts and revisit it if you have doubts later in the course.
- Concepts behind the 3D modelling of the built environment:
  - Different ways to conceptualise 3D modelling process (abstractions vs. chain)
  - Geometry, topology and semantics: links to branches of mathematics
  - Objects vs. fields
  - Data models and data structures

What to do next?

1. Today:
   - Homework 0 (install required software for C++ assignments)
   - Go to geo1004 website and study today's lesson (3D book Chapter 1)
   - If you have extra time, study Wednesday's lesson (3D book Chapter 2)
2. Wednesday: short lecture on b-rep, intro to homework 1 and help with any questions about this week's lessons or C++ installation

https://3d.bk.tudelft.nl/courses/geo1004

3D geoinformation
Department of Urbanism
Faculty of Architecture and the Built Environment
Delft University of Technology

References

- [21-25]: Level of detail in 3D city models. Filip Biljecki. PhD thesis. 2017.