Themen Bachelor-Arbeiten / Bachelor Thesis Topics

Frühlingssemester 2024 / Spring Semester 2024

Die folgende Liste enthält eine Sammlung aktueller Themen für Bachelor-Arbeiten im Bereich Geoinformations-Engineering.

Die konkrete Ausgestaltung eines Themas (Umfang, praxis- vs. forschungsorientierte Herangehensweise) oder auch eigene Vorschläge können Sie gerne mit uns diskutieren um die thematische Ausrichtung der Arbeit an Ihre individuellen Interessen anzupassen.

Vereinbaren Sie hierzu bitte einen Termin mit den Betreuern oder Leiter des jeweiligen Themas.

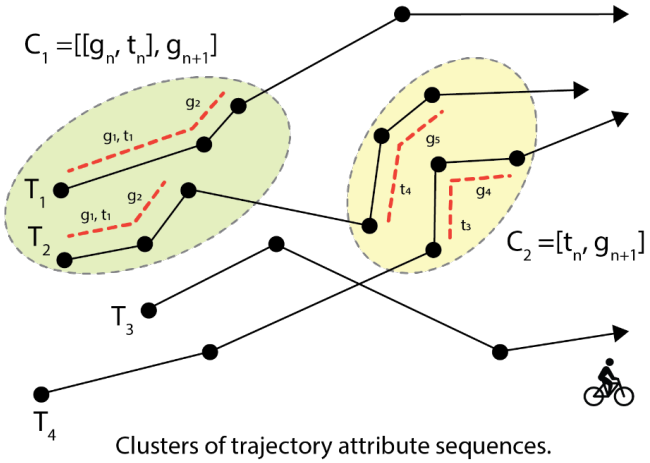
The following list covers a collection of possible thesis topics for Bachelor students in Geoinformation Engineering.

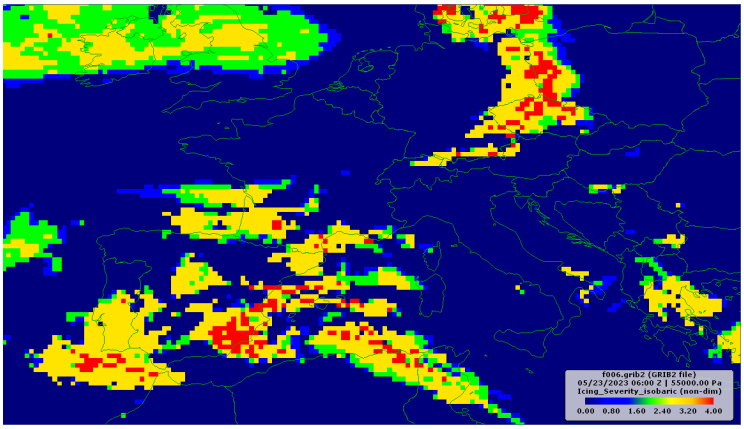
Your individual assignment will be adjusted with respect to scope and research/practical focus. You are also welcome to suggest topic adjustments to account for your individual interests.

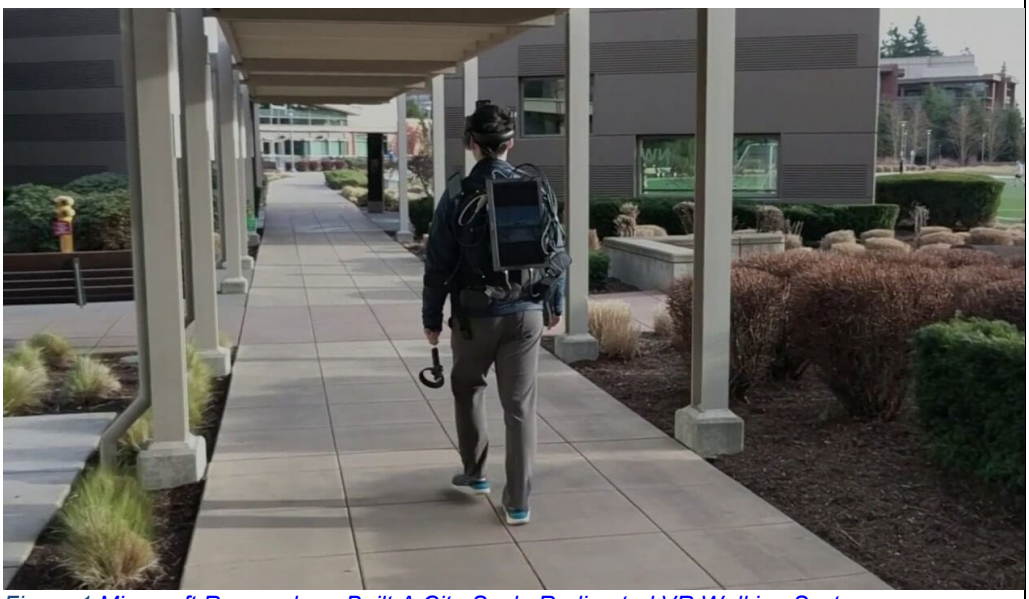
Please contact the advisor / supervisor of each respective topic for more information.

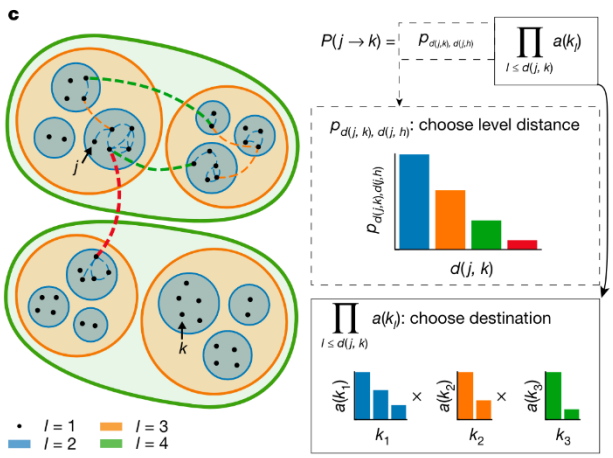
Table of Content - Inhaltsverzeichnis

Trajectory context integration and sequential pattern mining for active mobility behavior analysis 2
Effiziente Vektorisierung und Visualisierung von Wetterdaten.....3
Continuous walking in a large virtual environment in room-scale VR.....4
Exploring approaches to incorporate comprehensive travel behaviors into individual mobility models .5

Fachbereich:	**Geoinformations-Engineering**
Leiter/in Arbeit:	Prof. Dr. Martin Raubal (mraubal@ethz.ch)
Betreuer/in Arbeit:	Ayda Grisiute (agrisiute@ethz.ch) Ye Hong (hongy@ethz.ch)
Titel Arbeit:	**Trajectory context integration and sequential pattern mining for active mobility behavior analysis**
Beschrieb Arbeit:	The choice of active travel modes, such as walking and cycling, is notably influenced by immediate environmental context and requires a careful consideration of both negative (costs) and positive (benefits) factors. For instance, high traffic volume bears an adverse correlation with cycling, whereas the presence of green spaces incentivizes cycling [1]. However, it remains uncertain how these determinants are distributed within individual trajectories and whether recurring sequential patterns exist. The field of trajectory mining offers a range of methods to study human mobility behavior [2]. For instance, we can gain valuable insights into the decision-making heuristics people employ for route choice by mining trajectory data properties, such as number of turns [3]. Sequential pattern mining, a technique in this domain, can help uncover patterns of contextual information ordering within trajectory data. This thesis will explore recurrent sequential patterns in the provided trajectory data by considering positive (green spaces) and negative (traffic volume) contextual cycling determinants and will seek to reveal hidden ordered structures. Therefore, the primary objective for the student will be to develop a workflow that integrates trajectory data with these contextual elements, to identify common sequential clusters using clustering techniques while employing meaningful metrics for measuring distances between different contextual attribute sequences. A preliminary comparative analysis will contrast these attribute-based sequences with corresponding shortest path trajectories. The use of *trackintel,* a Python library designed for movement data processing and analysis, will be instrumental in streamlining the initial trajectory data preprocessing.  Clusters of trajectory attribute sequences. **References:** [1] Weikl, S., & Mayer, P. (2023). Data-driven quality assessment of cycling networks. Frontiers in Future Transportation, 4, 1127742. [2] Zheng, Y. (2015). Trajectory data mining: An overview. ACM Transactions on Intelligent Systems and Technology (TIST), 6(3), 29. [3] Teimouri, F., Richter, K.-F., & Hochmair, H. H. (2023). Analysis of route choice based on path characteristics using Geolife GPS trajectories. Journal of Location Based Services, 1–27.
Besonderes: (Bemerkungen zur Gruppenarbeit u.ä.)	The topic is supervised in English. A more specific introduction will be given by the advisor upon request. Experience with Python programming is beneficial. No group topic

Fachbereich:	**Geoinformations-Engineering**
Leiter/in Arbeit:	Prof. Dr. Martin Raubal (mraubal@ethz.ch)
Betreuer/in Arbeit:	Adrian Sarbach (asarbach@ethz.ch)
Titel Arbeit:	**Effiziente Vektorisierung und Visualisierung von Wetterdaten**
Beschrieb Arbeit:	Wetterdaten liegen häufig als Rasterdaten vor. Deren Verarbeitung und Visualisierung kann aufgrund der Menge an Daten, vor allem bei geographisch grossen Gebieten, zu längeren Ladezeiten und langsamem Rendering führen. Eine weitere Schwierigkeit liegt in der dreidimensionalen Natur von Wetterdaten, da sich das Wetter bekanntlich nicht nur am Boden, sondern in der ganzen vertikalen Atmosphäre abspielt.  *Wetterdaten auf 4865 m ü. M. über Europa im Rasterformat* Der erste Schritt dieser Bachelorarbeit zielt darauf ab, die originalen Rasterdaten automatisiert zu vektorisieren und zu vereinfachen. Verschiedene Methoden (z.B. Douglas-Peuker, Visvalingam, Bresenham, Catmull-Rom, Bezier) sollen dabei miteinander verglichen werden, z.B. in Hinblick auf die Geschwindigkeit, Genauigkeit, oder resultierende Dateigrössen. Dabei soll auch der dreidimensionale Aspekt der Daten berücksichtigt werden. In einem zweiten Schritt sollen die im ersten Schritt vorbereiteten Daten in 3D (z.B. in einer Game Engine wie Unity) visualisiert werden. Dabei soll vor allem darauf geachtet werden, dass die Ladezeiten gering sind und bei Interaktionen eine möglichst kurze Latenzzeit erreicht wird, während gleichzeitig auf die visuelle Attraktivität geachtet wird und eine gewisse «Realitätsnähe» (d.h. Nähe zu den Original-Daten) beibehalten wird.
Besonderes:	---
Gruppenarbeit:	Nein

Fachbereich:	**Geoinformations-Engineering und Kartografie**
Leiter/in Arbeit:	Prof. Dr. Martin Raubal (mraubal@ethz.ch)
Betreuer/in Arbeit:	Tianyi Xiao (xiaoti@ethz.ch) Peter Kiefer (pekiefer@ethz.ch)
Titel Arbeit:	**Continuous walking in a large virtual environment in room-scale VR**
Beschrieb Arbeit:	Virtual Reality (VR) is frequently used for studies on how humans perceive, interact with, and locomote in space. Different from studies in the real world, VR enables controlled experimental setups and systematic variation of the spatial environment. One drawback of VR, however, is that the way participants locomote through virtual space is highly unrealistic when implemented in a straightforward way, such as by using a controller. This is particularly problematic for studies in which the physical act of walking is considered a main part of the experimental design. In essence, the problem originates from studying a possibly infinite virtual space in the finite physical space of the VR lab. Enabling participants to explore an infinite virtual world in a limited physical space is an important practical problem for spatial cognition research that uses VR. Some existing solutions for this problem include redirected walking (RDW) and omnidirectional treadmills. In this thesis, the student will conduct a literature review to summarize existing solutions for continuous walking in a large virtual environment. Then, the student is expected to implement at least 2 solutions in Unity derived from open-source packages and conduct a simple comparative user study.  *Figure 1 Microsoft Researchers Built A City-Scale Redirected VR Walking System.*
Besonderes:	The topic is supervised in English. A more specific introduction will be given by the advisor upon request. Interest in spatial cognition and XR technologies, willingness to learn Unity, and a little bit of C# programming for HoloLens 2 development.
Gruppenarbeit:	no

Fachbereich:	Geoinformations-Engineering
Leiter/in Arbeit:	Prof. Dr. Martin Raubal (mraubal@ethz.ch)
Betreuer/in Arbeit:	Ye Hong (hongy@ethz.ch)
Titel Arbeit:	**Exploring approaches to incorporate comprehensive travel behaviors into individual mobility models**
Beschrieb Arbeit:	Mobility models quantitatively describe our movements from place to place, and are an indispensable component for many downstream applications, such as epidemic control and the planning of smart charging. Individual models aim to generate synthesized personal mobility traces statistically indistinguishable from real ones, and over recent years, we have witnessed significant advancements in reproducing high-level mobility statistics [1]. Still, most of these models are limited to describing individual location choices, without considering other activity travel dimensions, such as travel mode and activity type, that offer more fine-scaled knowledge regarding individual travel [2].  *([1])* This thesis explores the quantitative relationship between travel behaviors for modeling individual mobility. The student can access a large-scale, real-world GPS tracking dataset. We will build upon the knowledge from the container model [1], which reveals the hierarchical structure of location visits, and explore approaches to incorporate travel mode and activity information into their modeling framework. We will analyze the gained knowledge and accuracy when additionally considering these behavior dimensions and validate the synthetic traces against real-world tracking data. [1] Alessandretti, L., U. Aslak and S. Lehmann (2020) The scales of human mobility, Nature, 587 (7834) 402–407. [2] Hong, Y., H. Martin, Y. Xin, D. Bucher, D.J. Reck, K.W. Axhausen and M. Raubal (2023) Conserved quantities in human mobility: From locations to trips, Transportation Research Part C: Emerging Technologies, 146, 103979.
Besonderes:	The topic is supervised in English. A more specific introduction into the topic will be given by the advisor upon request. Experience with Python programming is beneficial. The student will need to sign an NDA to access confidential GPS tracking data.
Gruppenarbeit:	No