Highlights

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Digital Geosciences on Mobile Devices - Concepts, Challenges and Applications

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Abstract

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1. Introduction

- computing equipment continuously elevates the analytical capabilities for solving geoscientific problems
- large drawback on computing equipment: the more powerful it is, the more stationary it is
- geoscience disciplines such as hydrology, geology or glaciology are driven by outdoor experiments that prohibit bulky equipment
- the advent of mobile computing equipment, such as smartphones and tablets, provides a possible solution to the equipment problem

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- form factor of mobile devices is small enough to allow every field-related geoscientist to carry one in the field

- as seen is popular articles, the range of available devices increases, which allows to find a devices fit-for-purpose to each situation

- range of devices also comes with a range of capabilities that influence their usability for specific field tasks

- availability of small form factor devices is only on part contribution to making digital geosciences more "mobile"

- availability and easy access to geoscience data (e.g. domain-specific maps, digital elevation models (DEMs), surface models in 3D) is equally important to perform combined digital- and field analysis

- while basemap access on mobile devices is trivial, surface-scanned data in form of point clouds and (textured) triangulated meshes is becoming increasingly available with novice-operable structure from motion (SfM) software and drones

- crowdsourced data and Volunteered Geographic Information (VGI) provides numerous data for domain-specific analysis, which is facilitated by easier data capture from amateur scientists using mobile devices

- In order to connect data and devices in the field, domain-specific mobile software is required

- the difficulties in mobile software development stem from the specific demands and challenges for mobile software, such as energy efficiency, multi-manufacturer support, smart sensor utilisation [add and expand]

- with the emergence of new application cases, which are demonstrated and discussed in this article, and an increasing interest from geoscience- and computer technology industry, a significant rise in the mobile software availability for geoscience problem solving is expected for the near-term future

- Challenges

2. Target case studies

3. Representation basis – Geometry and Radiometry

4. Algorithms

4.1. Structure-from-Motion model generation

4.2. Image-to-geometry

4.3. Data representation and rendering

4.4. Interpretation and annotation

5. Technology

5.1. Sensors

5.1.1. Localization

5.1.2. Orientation

- stability IMU (see 3D-NO)
- precision IMU

5.1.3. Parameter sensitivity

5.2. Graphics

- software- vs hardware renderer
- web-rendering
- rendering-on-device
- hardware differences: speed, capability, CUDA

5.3. Power consumption

6. Applications and Requirements

Due to the increasing usability of mobile devices for in the field annotations, several use cases concerning geosciences has become apparent.

6.1. Derivation of hydrological parameters: Water level gauging

The last decade is characterized by a continued increase of globally devastating flash floods after heavy rainfalls. Even smallest creeks turned into hazardous streams causing flooding and landslides. Conventional gauging stations provide precise information about water levels measured over a short time period. For official gauges in Germany, standard derivation of one centimetre is required [1] [need more references]. But they are rather cost expensive in purchase and maintenance and thus just sparsely installed. Exemplary, the overall distribution of gauging stations in Saxony, Germany amounts to 154 compared to 259 creeks and rivers with small, medium and large catchments [2]. Thus, around a third can not be monitored neither during flood events when the most protection is required.

- recap: task to be solved
- main requirements for (location- and orientation) sensor accuracy and geometric accuracy
- specific requirements to this use case: data availability; illumination; device range to cover
- available approach to address the task

6.2. Field Geology

- recap: task to be solved
- main requirements for (location- and orientation) sensor accuracy and geometric accuracy

- specific requirements to this use case: data availability; illumination; network inavailability
- available approach to address the task

6.3. *Virtual Field Trips*

- recap: task to be solved
- main requirements for (location- and orientation) sensor accuracy and geometric accuracy
- specific requirements to this use case: data availability; illumination; network inavailability
- available approach to address the task

6.4. *The digital fieldbook*

- recap: task to be solved
- main requirements for (location- and orientation) sensor accuracy and geometric accuracy
- specific requirements to this use case: device range to cover; data integration; no network
- available approach to address the task

7. Conclusions

which problems are sufficiently solved ? which challenges remain that have already been discussed

8. Discussion

- porting existing desktop algorithms on mobile devices [quick and fast]
- vegetation in scans
- pre-processing of geodata for mobile use

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