

Preliminary Study of Scale Effect on Investigating Unknown Object Using Borehole Electrical Resistivity Tomography

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An in-situ experiment for investigating ground improvement using borehole electrical resistivity tomography method, also called BHERT, was performed and proposed at JPGU-2016 as well last year. In the study the simulated results from BHERT presented the roughly three dimensional distributing of the grouted materials of the ground improvement in deep underground soil layers. Despite the clear image being obtained, the operating parameters of BHERT and interpreting method make influence on the result, especially size effect. To clarify more details of the mentioned effect for further adoption, an in-situ with smaller size experiment was performed. A series tests with varies soil materials prepared and objects with different shapes buried inside was performed for setting up a standard reference. The result shows that a correcting factor is existing between object size, field size, and electrical parameters. The factors can be normalized to be unitless.

Keywords: Borehole Electrical Resistivity Tomography, Geophysical Investigating, Scale Effect



Making of a detailed DSM of a partially collapsed road embankment and correlation with 3D GPR data

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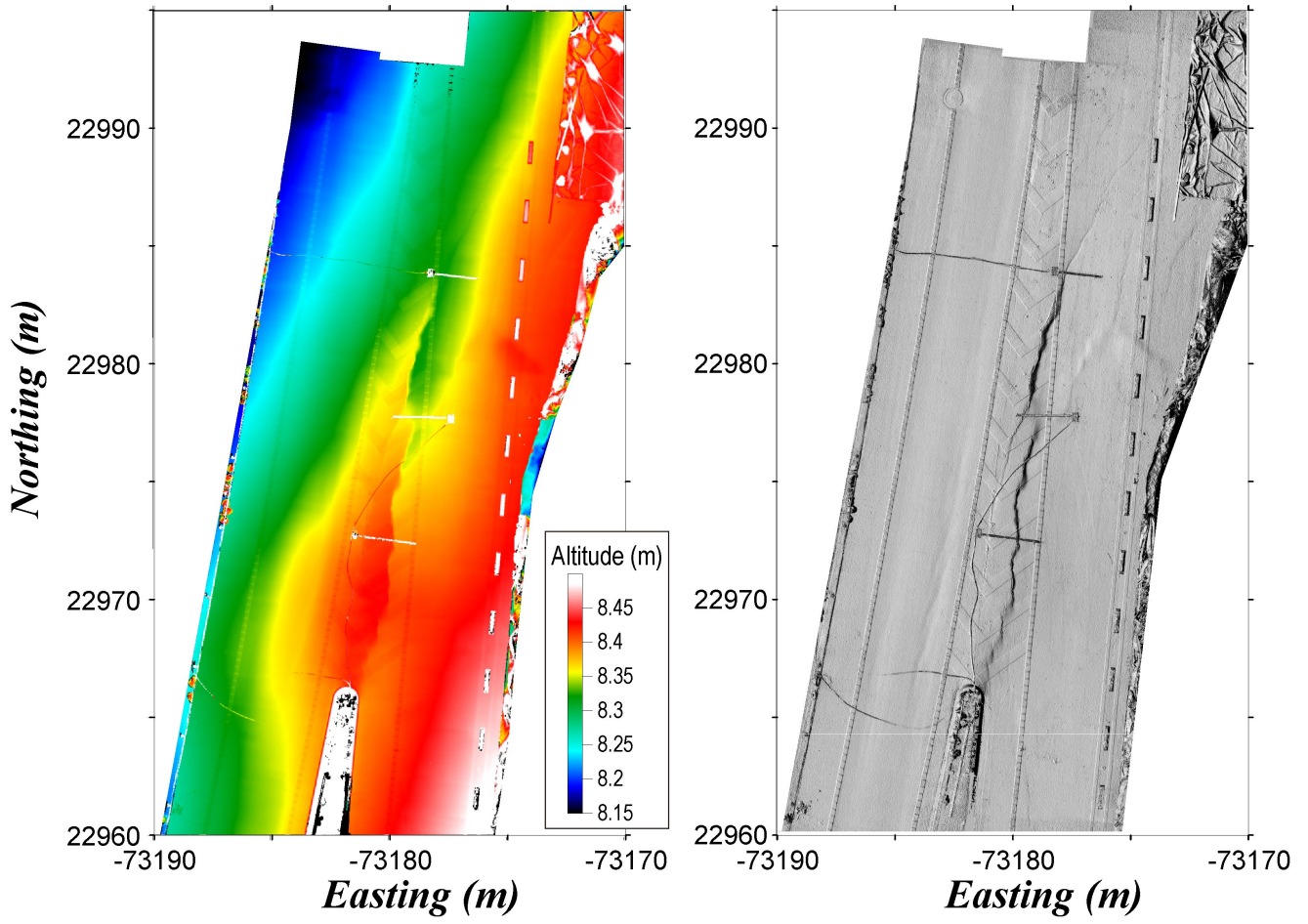
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We conducted an urgent but detailed field survey at a site where 8 m high road embankment slope had been partly collapsed by heavy rainfall along with strong motion of 2016 Kumamoto Earthquake 2 months before. The field measurements consisted of high-density surface photogrammetry and near-surface geophysical surveys. We employed a telescopic pole camera system and RICOH GR2 to take digital photographs in the air up to 6 meters. Finally, we made an orthophoto image and a DSM of a road surface which had escaped from collapsing at a spatial resolution of 2.86 mm using a commercial SfM-MVS (structure from motion and multi-view stereo) software package (Agisoft PhotoScan Professional). We used a total of 218 pole camera images and 7 GCPs to create the DSM. In addition, we processed UAV imagery taken on the day after the collapsing to generate a DSM of 2.5 cm spatial resolution of the site. The DSM, which covered 110 m x 90 m area, clearly imaged the embankment collapse and heaving of the ground in front of the failure caused by compression and thrusting. It was helpful to clarify the failure mechanism of road embankment and the role of geotextile-anchored concrete wall set at the foot part of the embankment to avoid entire collapsing of the embankment. Furthermore, we could identify non-tectonic structures from the road surface DSM. Number of cracks and small bulges were traced behind the failure crown, which indicated the co- or post-failure movement of the remained embankment. Then we conducted dense grid GPR survey on the road surface. As a result, cracks extended in the pavement up to 75 cm and the surface pavements were interpreted to be segmented and detached from the underlying road beds. Joint investigation and interpretation of the surface DSM and the near-surface geophysical data was capable to assess the safety conditions of remained road embankment. Namely, which types of restoration works were needed and what extent should be reinforced. In conclusion, combined analysis of surface DSM with the near-surface geophysical survey data is crucial to understand such surface deformation structures as slope failure.

キーワード：オルソ画像、数値表層モデル、無人航空機、地中レーダ、浅層物理探査

Keywords: Orthophoto, DSM, UAV, GPR, Near-surface Geophysics



遠隔調査船と高性能魚群探知機を利用した水底地形図の作成および底質マッピング

Bathymetry and bottom classification mapping by a remotely controlled watercraft and a high performance fish finder

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小水域と浅水域における音響調査は地球科学の諸分野や防災研究で重要である共に高い潜在的価値が見込まれる。例えば、氷河湖や地すべり閉塞湖における湛水量の推定は突発的な決壊洪水災害の予測としての有用であり、火口湖の水底のイメージングは水中の不可視の火山活動を観察する手段として有用である。しかしそのような調査はそのコスト、可搬性、有人観測の高い危険性があるが故に困難であった。筆者らは近年、軽量、低コストの最近の魚群探知機を利用して浅い水域の調査を行っている。今回、筆者らは前述の小水域・浅水域を調査する手段として同様の魚群探知機を備えた無人調査船システムについて開発を行ったのでそれを本講演において発表する。

開発したシステムは田房ほか（2013）を参考に、一般市販品や低価格電子デバイス、無償ソフトウェアで構成されている。無人船船体はエレキモーターと呼ばれる電気式の船外機と木製またはプラスチック製フロートを用い、双胴船構造になるようにした。その理由は、実験によって、このタイプの小型船においては、双胴船形態が波のある状況でも安定であったためである。エレキモーターは12Vで駆動し、リモコン制御機構を持つものである。この制御機構にZigBee無線デバイスをセットすることでその制御距離を約1kmまで拡張した。GNSS受信機をこの船体に設置し、その位置情報を同様の無線伝送デバイスで地上の操縦者に送信した。位置情報とGNSS情報から計算したスピード、船首方向をリアルタイムでPCディスプレイに表示させた。

筆者らは本装置を使用した調査として神奈川県芦ノ湖における研究を紹介する。湖の北部では湖底に多数の水没した木が発見されていた。そのうちのいくつかは立ったままであり、「逆杉」と呼ばれている。大木ら（1988）はこれらの水中林は地すべりによりもたらされたと推定していた。筆者らはもし地すべりによって水中林がもたらされたのであれば、水中林の周辺の地形とその底質が湖のその他の場所と異なると仮定し、その地域を開発したシステムにより調査した。その結果、得られた等深線図では、水中林の周辺に他の湖底とは異なる特徴的な高まりがあることが示された。また、得られた相対的な表面の硬さ値および表面粗度値の分布は水中林の底質が湖の大部分と異なることが示された。これは水中林が地すべりによって運ばれたという考えと矛盾しない。

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キーワード：魚群探知機、ソナー、浅深測量、遠隔調査、地すべり、芦ノ湖

Keywords: fish finder, sonar, bathymetry, remote investigation, landslide, Lake Ashinoko

Finite Element Modeling of Volcanic Ballistic Impacts in Soft Ash and on Buildings - a Hazard Approach

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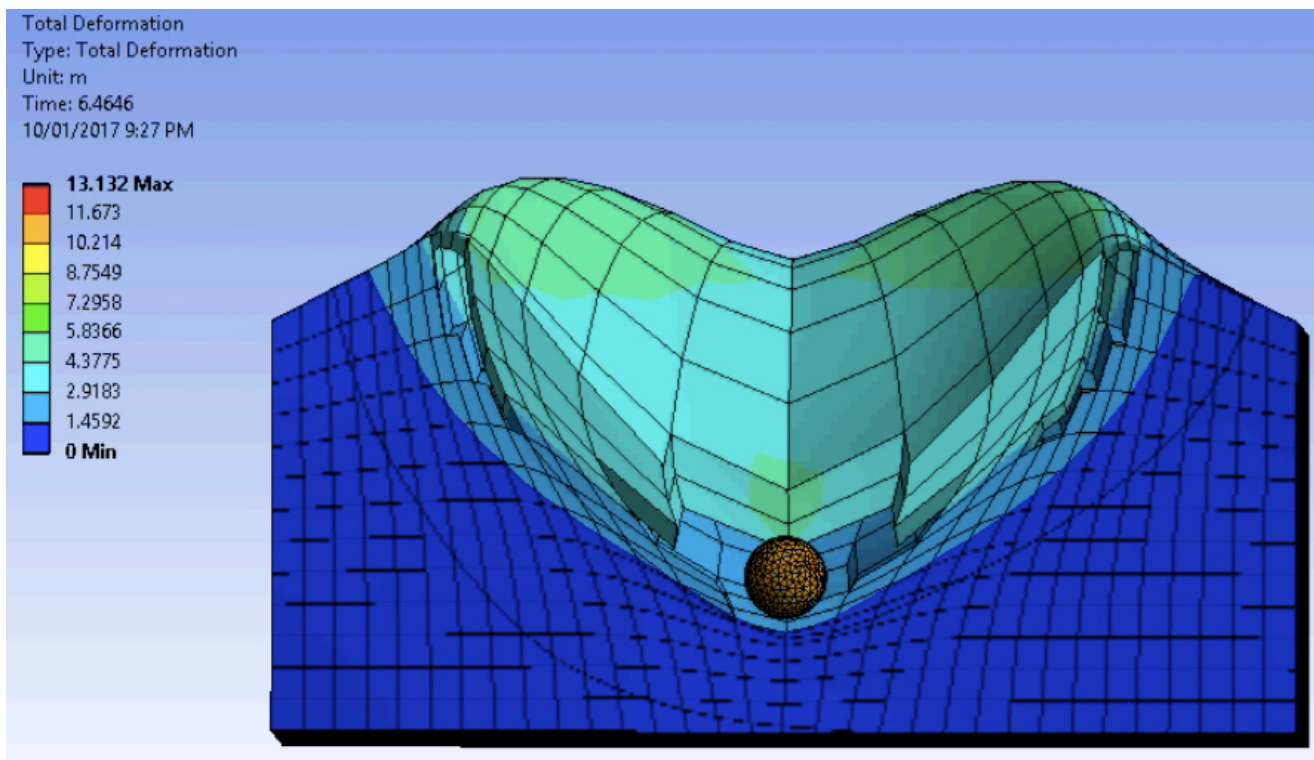
Volcanic eruptions, such as the phreatic eruption of 2014 at Ontake Volcano can produce large number of ballistics, which often turn into craters near the summit of the volcano, and which can have devastating effects on buildings.

In the present contribution, the authors have performed a visual analysis of the ballistic impacts at the summit of the Ontake Volcano on building materials and in soft clastic sediments and reproduced the time of impact between the ballistic and the impacted material.

The simulation was performed with the ANSYS engineering suite using andesite material for the projectile and timber and aluminum sheets to work on the impact on building. The timber planks had a 20 mm thickness and the aluminium sheets 0.5 mm. They were anchored along two parallel edges to simulate the supporting carpentry. Results reproduced the erosion of the impacted materials as observed in the field, with different effects depending on the penetration angle.

On the ground, the ballistic impacts recreated realistically the craters observed around the summit of the Ontake, showing an interesting feature of plastic decompression at the point of impact, allowing the projectile to slightly rebound.

Keywords: Ballistic, Impact Hazards, Ontake Volcano, Disaster Risk



Rockfall Simulation from DSM Data generated by SfM from UAV-based imagery: Analysing the rockfall hazards in the touristic Fox Valley.

Rockfall Simulation from DSM Data generated by SfM from UAV-based imagery: Analysing the rockfall hazards in the touristic Fox Valley.

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The Fox Valley, on the West Coast of the South Island of New Zealand, is a highly praised destination for tourists wanting to come up close to an alpine glacier and a majestic landscape. It is popular sightseeing spot and one of the main tourist resources, but such a dynamic environment can present several hazards, such as rockfalls. These events in the Fox valley are the results of some incidents, for instance valley deglaciation during the Quaternary and historic oscillation, eventually liberating multi-metric blocks. And one of the most active area where the tourists are concentrated is the Gunbarrel tributary, which threatens the carpark and the walking track.

In order to better understand the rockfall hazards and eventually reduce tourists' vulnerability, the present contribution proposes rockfall modelling using a Digital Surface Model (DSM) acquired by Structure-from-Motion (SfM) photogrammetry using a commercial quadcopter UAV and Terrestrial Laser Scanning (TLS). The model results were then analysed to assess the hazards and potentially the risk of rockfalls by using a GIS software and Flow-R which has been developed at the University of Lausann, Switzerland.

Results have shown that most of the rockfalls are meant to stop in the vicinity of the apron of the Gunbarrel tributary, being less of a threat to the walking track. But as the walking track cannot be placed too low due to potential river surges, which can be generated by glacier terminus collapse, the management remains a delicate issue. A talus formed by a large amount of rockfalls can become debris flow when it contains abundant water because due to rainfall. The model did not account for blocks that jump out of the present catchment and towards the carpark, although recent events in 2016 have shown that such rockfalls had happen. This limitation can be imputed to the model, but most certainly to the limitation of UAV-based DSM, which are difficult to acquire in terrain where the altitude change is ~1000 m, as it is at Gunbarrel. Another limitation to this analysis is the progressive change of the apron, where the accumulation of loose material has been increasing in 2016, due to a large number of debris-flows. The debris-flow fan deposits tend to reduce the slope break at the bottom in the apron, pushing the blocks further in the valley. Regular monitoring and repeats of the modelling are therefore essentials.

キーワード : rockfall, UAV, SfM, tourism, TLS

Keywords: rockfall, UAV, SfM, tourism, TLS

根尾谷断層水鳥断層崖における2013年と2016年のUAV飛行による DSMとオルソ画像の計測精度の比較

Comparison of measurement accuracy for DSM and orthomosaic between 2013 and 2016 UAV flights at Midori fault scarp, Neodani fault

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本研究の目的は、根尾谷断層水鳥断層崖で2013年と2016年のUAVによる観測で得られたDSMとオルソ画像の計測精度を比較することである。空中写真の解像度はそれぞれ3cmと1cmだった。そして、対象地区をカバーする写真枚数は109枚と498枚だった。DSMとオルソ画像は、SfM (Structure from Motion) の処理による高密度点群から生成された。RTK-GNSS測量によって、4つのGCPと7つの評価点3次元座標が得られ、GCPによってDSMとオルソ画像が幾何補正された。そして、評価点上の水平座標と標高がオルソ画像とDSMから計測され、最後に、計測値からGNSS測量値を差し引いた。水平方向の平均二乗誤差 (RMSE) は2013年については0.45m、2016年については0.05mだった。そして、標高のRMSEは2013年の0.32mと2016年の0.02mであった。この結果によって、2013年観測よりも、2016年観測のほうが水平方向で9倍、標高方向で16倍精度がよかったことがわかった。

キーワード：無人飛行機、SfM、精度

Keywords: UAV, SfM, accuracy

Detection of surface changes in sandstone blocks by weathering in a coastal environment using TLS

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Compared to the traditional measurement method, i.e., point to point, or cross-sectional measurements using scale bars, recent advantageous measurements using terrestrial laser scanning (TLS) enables more efficient and accurate measurements of the amount of weathering on the surface of vulnerable materials in coastal areas. We carried out multi-temporal TLS measurements to monitor the changes in the surficial morphology of sandstone blocks used for masonry piers of a bridge on a shore platform at Aoshima, Miyazaki Prefecture in western Japan. While the blocks have suffered from salt weathering above the sea level since the construction of the bridge in 1951, the weathering-induced depressions are still developing in the spray zone. The multiple measurements of the detailed morphology reveal the contemporary weathering rates.

キーワード：風化、砂岩、地上レーザ測量、岩盤強度

Keywords: weathering, sandstone, terrestrial laser scanning, rock strength