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Department of Civil Engineering  
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## Prizes

**Aalto University School of Engineering Award for Achievements in Teaching 2019**  
Janiszewski, Mateusz (Recipient) & Uotinen, Lauri (Recipient), Jan 2020

**Best poster award**  
Uotinen, Lauri (Recipient), 26 Sep 2013

**Best poster award**  
Uotinen, Lauri (Recipient), 20 Sep 2012

**Sinorock prize for Best Paper by Young Person outside China**  
Uotinen, Lauri (Recipient), 20 Jun 2013

**Young Rock Engineer Award**  
Uotinen, Lauri (Recipient), 24 Sep 2021

## Projects

**EMMEP/EMC: EMMEP/EMC**  
Paaso, M., Janiszewski, M., Antikainen, J., Uotinen, L. & Rinne, M.  
01/01/2014 → 31/12/2018

**Fractusan**  
Rinne, M., Oraskari, J., Karttunen, S., Sirkiä, J., Savikko, H., Szydłowska, M. & Uotinen, L.  
12/06/2017 → 31/01/2019

**GAGS: Geophysical and Geochemical Methods for Slope Design**  
Baghbanan, A., Kangas, L., Lange, M., Kangas, L., Laine, I., Janiszewski, M., Kiuru, R., Leveinen, J., Rinne, M. & Uotinen, L.  
01/10/2018 → 31/05/2022

**I2Mine (CP Large)**  
Rinne, M., Uotinen, L., Mishra, R., Szydłowska, M., Janiszewski, M., Siren, T., Sirkiä, J., Song, Z., Dong, S. & Samimi Namin, F.  
01/11/2011 → 31/10/2016

**ORMID: On-line Risk Management in Deep Mines**  
Rinne, M., Uotinen, L., Mishra, R., Kantia, P., Siren, T., Janiszewski, M., Kiuru, R., Szydłowska, M. & Caballero Hernandez, E.  
01/03/2016 → 31/12/2019

**RAKKA: Rakoilleen kalliomassan vedenjohtavuus**  
Rinne, M., Torkan, M. & Uotinen, L.  
01/02/2019 → 31/01/2020

**RAKKA: Rakoilleen kalliomassan vedenjohtavuus**  
Rinne, M., Hedström, O., Uotinen, L. & Torkan, M.  
01/02/2020 → 31/01/2021

**Rakoilleen kalliomassan vedenjohtavuus**  
Rinne, M., Hedström, O., Uotinen, L. & Torkan, M.  
01/02/2021 → 31/01/2022

**RAKKA: Rakoilleen kalliomassan vedenjohtavuus**  
Rinne, M., Torkan, M., Hedström, O. & Uotinen, L.  
01/01/2022 → 31/01/2023

**Reaaliaikainen kalliomekaaninen malli**  
Rinne, M. & Uotinen, L.  
01/01/2014 → 31/12/2015

**REMOS: REMOS TUTL**  
Rinne, M., Karttunen, S., Janiszewski, M., Hedström, O., Hulkkonen, T., Uotinen, L. & Tiainen, J.  
01/06/2019 → 30/04/2021

**Tackling the Challenges of a Solar Community Concept in High latitudes**  
Rinne, M., Uotinen, L., Janiszewski, M., Siren, T. & Caballero Hernandez, E.  
01/01/2015 → 31/12/2017

**VYR KARMO II**  
Rinne, M., Uotinen, L., Antikainen, J., Hedström, O. & Sirkiä, J.  
01/02/2015 → 31/01/2016

**VYR KARMO III 2017**  
Rinne, M., Hedström, O., Caballero Hernandez, E. & Uotinen, L.  
01/01/2017 → 31/01/2018

**VYR KARMO III 2018**  
Rinne, M., Caballero Hernandez, E., Hakala, V., Uotinen, L. & Szydlowska, M.  
01/02/2018 → 31/01/2019

## **Activities**

**International Workshop on Fracturing Geomechanics**  
Mateusz Janiszewski (Member), Mikael Rinne (Chair), Lauri Uotinen (Member), Otto Hedström (Member), Johannes Suikkanen (Member), Baotang Shen (Chair) & Ove Stephansson (Member)  
12 Jun 2019 → 13 Jun 2019

**Eurock 2015, Salzburg, 6.10.-9.10.2015, Austria**  
Lauri Uotinen (Contributor)  
2015

**The 13th International ISRM Congress 2015 International Congress on Rock Mechanics, Montreal, 10.-13.5.2016, Canada**  
Lauri Uotinen (Contributor)  
2015

**KTH Royal Institute of Technology**  
Lauri Uotinen (Visiting researcher)

2014

#### **University**

Lauri Uotinen (Student)  
2014

#### **University (External organisation)**

Lauri Uotinen (Chair)  
2012

## **Research outputs**

### **Photogrammetric Method to Determine Physical Aperture and Roughness of a Rock Fracture**

Torkan, M., Janiszewski, M., Uotinen, L., Baghbanan, A. & Rinne, M., 1 Jun 2022, In: *Sensors (Basel, Switzerland)*. 22, 11, 25 p., 4165.

### **Method for estimating rockfall failure probability using photogrammetry**

Uotinen, L., Janiszewski, M., Mishra, R., Munukka, H., Szydlowska, M., Martinelli, D. & Dabove, P., 6 Sep 2021, In: *IOP Conference Series: Earth and Environmental Science*. 833, 1, 8 p., 012063.

### **Monitoring of rock stress change using instrumented rebar rock bolts**

Mai, W., Janiszewski, M., Uotinen, L., Mishra, R. & Rinne, M., 6 Sep 2021, In: *IOP Conference Series: Earth and Environmental Science*. 833, 1, 9 p., 012141.

### **Photogrammetry based characterization of hydro-mechanical properties of a rock fracture**

Torkan, M., Uotinen, L., Nieminen, V. & Rinne, M., 6 Sep 2021, In: *IOP Conference Series: Earth and Environmental Science*. 833, 1, 9 p., 012019.

### **Photogrammetric prediction of rock fracture properties and validation with metric shear tests**

Uotinen, L., Torkan, M., Baghbanan, A., Hernández, E. C. & Rinne, M., Jul 2021, In: *Geosciences (Switzerland)*. 11, 7, 31 p., 293.

### **A Bayesian network approach for geotechnical risk assessment in underground mines**

Mishra, R., Uotinen, L. & Rinne, M., Jun 2021, In: *Journal of the Southern African Institute of Mining and Metallurgy*. 121, 6, p. 287-294 8 p.

### **Visualization of 3D rock mass properties in underground tunnels using extended reality**

Janiszewski, M., Uotinen, L., Szydlowska, M., Munukka, H. & Dong, J., 23 Apr 2021, In: *IOP Conference Series: Earth and Environmental Science*. 703, 1, 6 p., 012046.

### **Characterization of hydro-mechanical properties of rock fractures using steady state flow tests**

Uotinen, L., Torkan, M., Janiszewski, M., Baghbanan, A., Nieminen, V. & Rinne, M., 13 Nov 2020, *ISRM International Symposium - EUROCK 2020*. Li, C. C., Odegaard, H., Høien, A. H. & Macias, J. (eds.). Norsk Betongforening, 8 p.

### **Digitisation of hard rock tunnel for remote fracture mapping and virtual training environment**

Janiszewski, M., Uotinen, L., Baghbanan, A. & Rinne, M., Nov 2020, *ISRM International Symposium - EUROCK 2020: International Society for Rock Mechanics and Rock Engineering Norwegian Group for Rock Mechanics*. Li, C. C., Ødegaard, H., Høien, A. H. & Macias, J. (eds.). Norsk Betongforening, 8 p.

### **Virtual Reality Learning Environments for Rock Engineering, Geology and Mining Education**

Janiszewski, M., Uotinen, L., Merkel, J., Leveinen, J. & Rinne, M., 22 Sep 2020, *54th U.S. Rock Mechanics/Geomechanics Symposium, 28 June - 1 July: physical event cancelled*. American Rock Mechanics Association, 7 p. ARMA-2020-1101

### **Accuracy of GPR based 3D fracture surface geometry interpretation**

Kiuru, R., Kantia, P. & Uotinen, L., 12 Dec 2019.

### **Kalliorakenteiden digitointi valokuvamittauksen avulla**

Uotinen, L., 23 Oct 2019, In: *Geofoor*. 49, p. 22-23 2 p.

### **VR learning environments for rock engineering and mining education**

Janiszewski, M., Uotinen, L., Merkel, J., Leveinen, J. & Rinne, M., 18 Oct 2019, p. 13.

### **Photogrammetry for recording rock surface geometry and fracture characterization**

Uotinen, L., Janiszewski, M., Baghbanan, A., Caballero Hernandez, E., Oraskari, J., Munukka, H., Szydłowska, M. & Rinne, M., 17 Sep 2019, *Proceedings of the 14th International Congress on Rock Mechanics and Rock Engineering (ISRM 2019), Foz do Iguassu, Brazil, 13-18 September 2019: Rock Mechanics for Natural Resources and Infrastructure Development - Full Papers*. da Fontoura, S. A. B., Rocca, R. J. & Pavón Mendoza, J. F. (eds.). p. 461-468 8 p. (Proceedings in Earth and geosciences; vol. 6).

### **Combining expert opinion and instrumentation data using Bayesian networks to carry out slope collapse risk assessment**

Mishra, R., Kiuru, R., Uotinen, L., Janiszewski, M. & Rinne, M., 9 Apr 2019, *Mining geomechanical risk 2019 : Proceedings of the First International Conference on Mining Geomechanical Risk*. Perth: Australian Centre for Geomechanics, p. 85-96 12 p.

### **Effective modelling of borehole solar thermal energy storage systems in high latitudes**

Janiszewski, M., Siren, T., Uotinen, L. K. T., Oosterbaan, H. & Rinne, M., 10 Dec 2018, In: *GEOMECHANICS AND ENGINEERING*. 16, 5, p. 503-512 10 p.

### **In Situ Experiment and Numerical Model Validation of a Borehole Heat Exchanger in Shallow Hard Crystalline Rock**

Janiszewski, M., Caballero Hernandez, E., Siren, T., Uotinen, L., Kukkonen, I. & Rinne, M., 17 Apr 2018, In: *Energies*. 11, 4, 21 p., 963.

### **Prediction of stress-driven rock mass damage in spent nuclear fuel repositories in hard crystalline rock and in deep underground mines**

Uotinen, L., 2018, Aalto University. 164 p.

### **Numerical predictions for underground thermal energy storage experiment in the Otaniemi research tunnel**

Janiszewski, M., Caballero Hernandez, E., Siren, T., Uotinen, L. & Rinne, M., 11 Oct 2017, *3rd Nordic Rock Mechanics Symposium NRMS 2017 : Symposium Proceedings*. Johansson, E. & V. R. (eds.). Suomen rakennusinsinöörien liitto RIL, p. 77-85 9 p. (RIL / Suomen rakennusinsinöörien liitto).

### **Modelling of Borehole Solar Energy Storage Concept in High Latitudes**

Siren, T., Janiszewski, M., Uotinen, L. K. T. & Oosterbaan, H., 11 May 2017, *2017 YSRM Young Scholars' Symposium on Rock Mechanics: Proceedings of Korea*, p. 369-372 4 p.

### **Elastoplastic Modelling of an In Situ Concrete Spalling Experiment using the Ottosen Failure Criterion**

Uotinen, L. & Siren, T., 31 Jan 2017, In: *Journal of Engineering*. 2017, 17 p., 4723017.

### **A method to downscale joint surface roughness and to create replica series using 3D printed molds**

Uotinen, L., Korpi, E., Hartikainen, A., Yorke, R., Antikainen, J., Johansson, F. & Rinne, M., 2017, *ISRM 13th International Congress on Rock Mechanics, Montreal, May 10-13, 2015*. Canadian Institute of Mining, Metallurgy and Petroleum, 11 p.

### **Bayesian Network Approach for Geotechnical Risk Assessment in Underground Mines**

Mishra, R., Uotinen, L. K. T. & Rinne, M., 2017, (Submitted) In: *Safety Science*.

### **Geotechnical risk management concept for intelligent deep mines**

Mishra, R., Janiszewski, M., Uotinen, L., Szydłowska, M., Siren, T. & Rinne, M., 2017, *Symposium of the International Society for Rock Mechanics*. Elsevier, Vol. 191. p. 361-368 (Procedia engineering; vol. 191).

**Numerical thermal back-calculation of the Kerava Solar Village underground thermal energy storage**  
Oosterbaan, H., Janiszewski, M., Uotinen, L., Siren, T. & Rinne, M., 2017, In: *Procedia Engineering*. 191, p. 352-360 8 p.

**Pull Experiment to Validate Photogrammetrically Predicted Friction Angle of Rock Discontinuities**  
Dzugala, M., Sirkiä, J., Uotinen, L. & Rinne, M., 2017, *Symposium of the International Society for Rock Mechanics*. Elsevier, p. 378-385 8 p. (*Procedia engineering*; vol. 191).

**Real-Time Risk Assessment and Ground Support Optimisation in Underground Mines**  
Mishra, R., Ritala, F., Janiszewski, M., Uotinen, L. & Siren, T., 14 Oct 2016, *Proceedings of the Eighth International Symposium on Ground Support in Mining and Underground Construction: Ground Support 2016*. Nordlund, E., Jones, T. H. & Eitzenberger, A. (eds.). Luleå, 12 p. 209

**Using Observational Method to Manage Safety Aspects of Remedial Grouting of Concrete Dam Foundations**  
Spross, J., Johansson, F., Uotinen, L. K. T. & Rafi, J. Y., Oct 2016, In: *Geotechnical and Geological Engineering*. 34, 5, p. 1613-1630 18 p.

**Feasibility of underground seasonal storage of solar heat in Finland**  
Janiszewski, M., Kopaly, A., Honkonen, M., Kukkonen, I., Uotinen, L., Siren, T. & Rinne, M., 29 Sep 2016, *International Conference on Geo-mechanics, Geo-energy and Geo-resources: Conference Proceedings*. PG, R. & Jian, Z. (eds.). Melbourne, Australia: Monash University, p. 959-965 7 p. 236

**Photogrammetric calculation of JRC for rock slope support design**  
Sirkiä, J., Kallio, P., Iakovlev, D. & Uotinen, L., 14 Sep 2016, *Proceedings of the Eighth International Symposium on Ground Support in Mining and Underground Construction: Ground Support 2016*. Nordlund, E., Jones, T. H. & Eitzenberger, A. (eds.). Luleå, 13 p.

**Determination of joint mechanical parameters for stability analysis in low stress open pit mines**  
Iakovlev, D., Sirkiä, J., Kallio, P. & Uotinen, L., 12 May 2016, *7th International Symposium on In-Situ Rock Stress: Symposium Proceedings*. Johansson, E. & Raasakka, V. (eds.). Tampere, Finland: Suomen rakennusinsinöörien liitto RIL, p. 625-634 10 p. (RIL).

**Stress State Change Monitoring Using Displacement Change Measurements**  
Ritala, F., Siren, T. & Uotinen, L., 12 May 2016, *7th International Symposium on In-Situ Rock Stress: Symposium Proceedings*. Johansson, E. & Raasakka, V. (eds.). Tampere, Finland: Suomen rakennusinsinöörien liitto RIL, 9 p. (RIL).

**Thermally Induced Rock Stress Increment And Rock Reinforcement Response**  
Ström, J., Hakala, M., Suikkanen, J., Siren, T., Uotinen, L. & Nuijten, G., 10 May 2016, *7th International Symposium on In-Situ Rock Stress: Symposium proceedings*. Johansson, E. & Raasakka, V. (eds.). Tampere, Finland: Suomen rakennusinsinöörien liitto RIL, 10 p. (RIL).

**Fracture Mechanics Modelling of an In Situ Concrete Spalling Experiment**  
Siren, T., Uotinen, L., Rinne, M. & Shen, B., 2015, In: *Rock Mechanics and Rock Engineering*. 48, 4, p. 1423-1438

**Real time stress change estimation using strain measurements**  
Kodeda, S., Ritala, F., Siren, T. & Uotinen, L., 2015, *Eurock 2015 & 64th Geomechanics Colloquium, Salzburg, Austria, October 7-10, 2015*. Schubert, W. & Kluckner, A. (eds.). Graz: Austrian Society for Geomechanics, p. 1071-1076

**Thermally Induced Rock Stress Increment and Rock Reinforcement Response**  
Hakala, M., Ström, J., Nuijten, G., Uotinen, L., Siren, T. & Suikkanen, J., 15 Aug 2014, POSIVA OY, 72 p.

**Improving teaching methods of rock mass classification parameters**  
Barbens, P. T., Uotinen, L., Toivanen, T-L. & Edelbro, C., 2014, *Eurock 2014. Rock Engineering and Rock Mechanics: Structures in and on Rock Masses, Vigo, Spain 26-28 May 2014*. Alejano, L. R., Peruchó, A., Olalla, C. & Jimenez, R. (eds.). Leiden, p. 451-455

## **Kalliotekniikan kerho KTK**

Hurskainen, P. & Uotinen, L., 2014, In: MATERIA. 3, p. 70

## **Modified yield-line theory approach to determine sprayed concrete flexural capacity**

Uotinen, L., Suikkanen, J. & Siren, T., 2014, *7th International Symposium on Sprayed Concrete, Sandefjord, Norway, 16.-19. June 2014: Modern Use of Wet Mix Sprayed Concrete for Underground Support*. Beck, T., Woldmo, O. & Engen, S. (eds.). The Norwegian Society of Chartered Technical and Scientific Professionals (Tekna), p. 387-400

## **Design of sprayed concrete as hard rock reinforcement using yield-line theory**

Uotinen, L. K. T., Salo, O. & Rinne, M., 2013, *Rock Characterisation, Modelling and Engineering Design Methods - Proceedings of the 3rd ISRM SINOROCK 2013 Symposium*. p. 817-822 6 p.

## **In-situ experiment concerning thermally induced spalling of circular shotcreted shafts in deep crystalline rock**

Uotinen, L., Siren, T., Martinelli, D. & Hakala, M., 2013, *World Tunnel Congress 2013, Switzerland, May 31- June 7, 2013*. Anagnostou, G. & Ehrbar, H. (eds.). London, p. 808-815

## **Semiautomatic Characterization of Rock Masses Using Photogrammetry, 3D Printing Technology and Ground Penetrating Radar**

Uotinen, L., Song, Z., Hedström, O., Huuskonen-Snicker, E., Toivanen, T-L., Palmén, J. & Hokkanen, T., 2013, p. 108-108 . 1 p.

## **Rock engineering design process in ONKALO rock characterisation facility**

Uotinen, L., Nuijten, G., Martinelli, D., Lehmusjärvi, R. & Rinne, M., 30 May 2012, *Rock Engineering and Technology for Sustainable Underground Construction EUROCK 2012, Stockholm 28-30.5.2012*. Stockholm: BeFo - Rock Engineering Research Foundation & Swedish National Group of ISRM, 11 p.

## **Rock mechanical modelling of Keilaniemi metro station of Länsimetro in Finland**

Martinelli, D., Ström, J., Westerlund, G., Uotinen, L. & Nuijten, G., 2012, *Rock Engineering and Technology for Sustainable Underground Construction EUROCK 2012, Stockholm 28-30.5.2012*. Stockholm: BeFo - Rock Engineering Research Foundation & Swedish National Group of ISRM, 11 p.

## **Assessment of the Potential for Rock Spalling in the Technical Rooms of the ONKALO: Work Report 2011-35**

Uotinen, L., Siren, T. & Martinelli, D., 10 Aug 2011, POSIVA OY, 40 p.

## **Design of shotcrete rock reinforcement in hard rock according to Eurocode**

Uotinen, L., 6 Jun 2011, *Seminar on Geoengineering*. 21 p.

## **Eurocodes in Hard Rock Engineering in Finland**

Uotinen, L., Nuijten, G., Siren, T., Stöm, J., Hakala, M. & Rinne, M., 22 May 2011, *ITA-AITES World Tunnel Congress, Helsinki 20-26.5.2011*. Helsinki: Finnish Tunnelling Association MTR, p. 126-127

## **Numerical spalling assessment methods in crystalline rock during the design of ONKALO rock characterization facility**

Siren, T., Martinelli, D., Uotinen, L., Nuijten, G. & Lehmusjärvi, R., 22 May 2010, *World Tunnel Congress 2011: Underground spaces in the service of a sustainable society*. 8 p.

## **Spalling prediction methods in high stress conditions**

Siren, T., Uotinen, L., Ström, J., Lehmusjärvi, R. & Rinne, M., 2 Oct 2009, *Get Underground 2009: Underground Space Seminar*. 11 p.

## **Stochastically Determined Safety of Underground Structures According to Eurocode**

Uotinen, L., Siren, T. & Lehmusjärvi, R., 2 Oct 2009, *Get Underground 2009: Underground Space Seminar*. 10 p.

## **Press/Media**

**Design of shotcrete rock reinforcement in hard rock according to Eurocode.pdf**

Lauri Uotinen

14/06/2018

1 item of Media coverage

**Suomalaistutkija sai merkittävän palkinnon – tutkii kivien putoamista kallioleikkauksissa**

Lauri Uotinen

30/09/2021

1 item of Media coverage

**Suomalaistutkija sai merkittävän palkinnon – tutkii kivien putoamista kallioleikkauksissa**

Lauri Uotinen

01/10/2021

1 Media contribution