ROCK REPORT

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RMT

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Content

Marcher's Column

1992 - 2022: 30 years of the Institute of Rock Mechanics and Tunnelling at TU Graz. Time to celebrate! And that's what we did and want to inform you in detail about the celebrations with this special edition Rock Report.

Dear friends of the institute, since I am only entitled to 4/30 of the celebration, I will leave as much space as possible for my predecessor, Prof. Wulf Schubert, to look back. On the following pages you can read his thoughts on the Institute's 30 years, as well as anecdotes from some of the Institute's former PhD students/assistants. The event was framed by musical appetisers from a local jazz band.

Afterwards, the Saint Barbara's Day Celebration could also - 2x suspended due to the pandemic - finally be celebrated again. Read more about this event in this issue of the Rock Report.

The 3rd event was the Rockfall symposium in Schladming. A stunning success with participants from all provinces of Austria as well as from Germany and South Tyrol/Italy. Details of this event are also given below.

With this issue of the Rock Report we have a new editor-in-chief, Tom Geisler. Thank you for taking on this task and at the same time many thanks to the last editor-in-chief, Manuel Winkler! Thanks to Angelika Klammer for her active support in organising and compiling contributions for the 30th anniversary and the Saint Barbara's Day Celebration.

We thank you for the trustful cooperation and wish you peaceful and beautiful hours for Christmas. The very best season greetings. Good health, happiness and success for 2023! We look forward to many new tasks and a good time together.

Glück Auf 2023!

Thomas Marcher

Title Picture:
Photo of one of the St. Barbara's candles, which was handed over at the St. Barbara's celebration to our loyal sponsors as a sign of appreciation.

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30 Years of RMT

30 years Institute of Rock Mechanics and Tunnelling – looking back

Wulf Schubert

Originally the fields of rock mechanics and tunnelling at the Graz University of Technology were taken care of by the Institute of Soil Mechanics, Foundation Engineering and Rock Mechanics. Considering the leading role of Austrian engineers in both fields, the TUG decided to create an own Institute for Rock Mechanics and Tunnelling in the late 1980ies.
Colleagues and friends persuaded me to apply for the position, although to become professor never had been my plan. The appointment procedure took some time, and I had nearly forgotten about the position, when I received a call from the dean, if I would be ready to talk. Meanwhile the project I was working on was about to be completed, and I had to look for a new challenge. The negotiations with the Ministry went quite smooth, so I started on October 1st, 1992 at the University. It seems that the University was not expecting such a quick decision, as there was no budget at all, as well as very limited temporary office space.

With a lot of creativity and nightshifts the lecture notes and lectures were prepared, not always catching up with the demand; team members had to be acquired, laboratory equipment selected and purchased. Eventually everything was set up and we could start with research. The focus was set on tunnelling in Alpine conditions, with special consideration of fault zones and foliated rock mass. Ductile elements, developed at the institute are now common practice at tunnels in fault zones Around 25 PhD theses and more than 100 master theses were prepared during the 26 years I was heading the institute. We were rather fortunate, as a considerable number of tunnel projects were under construction during this time. Due to an excellent cooperation with owners, contractors, and industry we had the chance not only to acquire a lot of data, but also could test our ideas on site. A lot of effort was spent on the evaluation of monitoring data in relation to the geological/geotechnical conditions, and new methods for data interpretation were developed.

In cooperation with the Leoben University a Master Course in tunnelling was created, which attracted a large number of students from around the world.
It was a real pleasure to work with motivated researchers, who enthusiastically took up new ideas and tried to further the state of the art. Besides hard work, there was always time for some fun. Various sporting events, like kayaking, skiing, or paragliding were welcome opportunities to clear the head after intensive working weeks.

Last, but not least, real friendships have been formed among the team.

I am looking back to real quality time and wish Thomas and his team successful years with the institute!

Glück Auf!
Wulf Schubert

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30 Years of RMT

Statements by Wulf Schubert's former assistants 1/7[1]

Manfred Blümel
From 1992 till today at the institute.

Unser Institut ging aus dem Institut für Bodenmechanik, Grundbau und Felsmechanik hervor. Unter Professor Fuchsberger hatte Rudi Laneve die Felsmechanik über.
1992 wurde dann das Institut für Felsmechanik und Tunnelbau gegründet. Die österreichische Bauwirtschaft erkannte die Notwendigkeit eines eigenen Instituts für den Tunnelbau, welcher ja eine große Tradition bei uns besitzt (Stichwort, alte und neue österreichische Tunnelbauweise). Ich glaube es war Professor Raaber von unserem damaligen Bauwirtschaftsinstitut, der es einfädelte, dass wir 5 Millionen Schilling zusätzliches Startkapital bekamen, wovon wir letztendlich auch nicht alles abrufen konnten.
Andi Budil war der erste Assistent am Institut, zu Beginn im Sommer 1992noch in der Bodenmechanik einquartiert. Wulf Schubert ist erst mit Beginn des Herbstsemesters nach Graz gekommen. Vorher war er noch für die GC am sehr interessanten Projekt Inntaltunnel tätig.
Ich habe mich dann für die 2. Assistentenstelle beworben. Vorher war ich 3 Jahre bei einem Zivilingenieurbüro in Leibniz beschäftigt. Meine Anstellung an der Universität begann mit Dezember 1992, also ganz genau vor 30 Jahren.
Naturgemäß gab es Anlaufschwierigkeiten, so wie es beim Neustart eines Instituts und eines Labors eben ist. Möbel mussten aus dem Fundus geholt werden, es gab kein Wasser im Labor, die Bewehrung der Bodenplatte musste verstärkt werden, die Gesteinsbearbeitung erfolgte in einem anderen Gebäude und die Gerätschaften entsprachen nicht immer unseren Vorstellungen. Für unser Planschleifgerät musste sogar ein Türstock entfernt und seitliche Ausnehmungen im altehrwürdigen Gebäude der TU Graz vorgenommen werden. Und dann hieß es natürlich schnell Vorlesungsskripten für den Studienbetrieb zu erstellen.
Im Labor kam dann auch bald Toni Kaufmann als Labortechniker dazu. Gemeinsam konnten wir alle anfänglichen Schwierigkeiten meistern.
International bekannte Professoren (z.B. Goodman, Einstein, Hudson) beehrten uns mit Kursen und Gastvortägen. Professor Dick Goodman, der auch ein ausgezeichneter Opernsänger ist, gab uns bei einer Weihnachtsfeier eine musikalische Darbietung.
Wir hatten dann auch sehr schöne gemeinsame Freizeitaktivitäten wie z.B. Städtereisen und Exkursionen, sportliche Schiausflüge auf Liesls und Wulfs Hütte in Obertauern, inklusive sehr fordernder Spieleabende (z.B. Mäx´chen, Activity usw.), Paddeln, Paragleiten und Tennis.
Rückblickend war dies, so glaube ich, eine sehr schöne Zeit für uns alle.

Vielen Dank und ein herzliches Glück Auf!

[1]We apologize to international readers that this article is not available in English.

30 Years of RMT

Statements by Wulf Schubert's former assistants 2/7[1]

Andreas Buyer
From 2015 to 2019 at the institute.

Meine Zeit am Institut hat mir mehrere Sachen beschert wie z.B. Wissen, Erfahrungen, neue Freunde und Bekannte. Das alles fasse ich unter immaterielle Dinge zusammenfassen und stelle fest, dass ich einiges davon dem Institut zu verdanken habe. Im Gegensatz dazu habe ich an materiellen Dingen außer ein paar Stiften, einer Hose und den obligatorischen Geologen-Handstücken nichts mitgenommen. Aber dann ist da noch der Wulf'sche Sumpfkaktus.
Wulf hatte seinerzeit einen deckenhohen Sumpfkaktus in seinem Büro stehen. Deckenhoch bedeutet auf der alten Technik etwa 4 bis 5 m. Das ist eine ordentliche Höhe – v.a. in Anbetracht dessen, dass der Topf, in welchem der Kaktus stand, relativ klein war. Wie auch Wulf ist so ein Sumpfkaktus recht sparsam: Außer Wasser, Luft und Licht braucht er eigentlich nichts. Damit er bei seiner Größe und dem kleinen Topf nicht umfällt wird er mit Steinen beschwert. Zusammengefasst, ein äußerst pflegeleichtes und platzsparendes Gewächs – wenn da nicht das Risiko des Umfallens und die doch recht langen Dornen wären.
Unsere damalige Sekretärin Anja Friedrich hatte mir einmal erzählt, dass dieser deckenhohe Sumpfkaktus eines Nachts umgefallen sei und direkt auf dem Besprechungstisch in Wulfs Büro gelandet wäre. Von da an hatte ich einen riesen Respekt vor dem Kaktus und habe stets beim Betreten des Büros erst mal geschaut ob der Kaktus noch „standsicher" ist. Bei Besprechungen habe ich mich auch immer außerhalb der Schussbahn platziert. Es gab seid dem also noch eine zweite, beeindruckende Persönlichkeit im Büro des Chefs.
Als Wulfs Büro ausgemalt werden musste, musste auch der Wulf'sche Sumpfaktus weichen. Die bis dahin zweite Persönlichkeit wurde – vermutlich unter einigem Fluchen der Möbelpacker – aus dem Zimmer raus und auf den Gang gestellt. Vor lauter Protest ob der unsanften Behandlung hat der Kaktus gleich mal ein paar Äste abgeworfen. Und als wohl langlebigste Verbindung zum Institut – die aber niemals Früchte tragen wird – habe ich mir einen solchen Zweig geschnappt und in einen kleinen Topf mit viel Wasser und Steinen gegeben und ans Fenster gestellt. Er entwickelt sich prächtig und wird mit großer Wahrscheinlichkeit auch irgendwann mal deckenhoch sein und zu einer dominanten Persönlichkeit heranwachsen, die mich immer an Wulf, die Besprechungen in seinem Büro und das Institut erinnern wird. Der stachelige Teufel ist jetzt schon fast so hoch wie das Fenster und wird wohl bald siedeln müssen.

[1]We apologize to international readers that this article is not available in English.

30 Years of RMT

Statements by Wulf Schubert's former assistants 3/7[1]

Andreas Gaich
From 1995 to 2000 at the institute.

Was man abseits der fachlichen Weiterbildung am Institut für Felsmechanik im Allgemeinen und von Wulf Schubert im Speziellen lernen konnte (wenn man wollte)

Gezeigt wurde anhand zweier Fallbeispiele, welche zusätzlichen Ausbildungsinhalte für Dissertanten durch den Professor möglich gewesen sind. Geschildert wurden Problemlösungen und Verhaltensweisen, die sich im Nachgang der Konferenzen der ARMA in Vancouver und San Francisco ereignet haben.
Dafür ein herzliches Dankeschön und Glück Auf!

Als Fazit konnten folgende Lerninhalte/Erkenntnisse gewonnen werden:

1. Ruhe bewahren
2. Kurzfristig anstehende Probleme (cf. kein Kleingeld für Bus) unmittelbar und pragmatisch lösen
3. Ausruhen, wenn sich die Gelegenheit bietet
4. Immer das richtige Schuhwerk parat haben
5. Söwa denken (cf. Ankunft Sausalito)
6. Ein wenig Geselligkeit schadet auch in größeren Mengen nie (cf. Vancouver, Sausalito, San Francisco,…)
7. Nicht gleich anscheiXen
8. Keine Sorge haben, wenn man die eigene Redezeit schamlos überzieht

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30 Years of RMT

Statements by Wulf Schubert's former assistants 4/7[1]

Karl Großauer
From 2004 to 2008 at the institute.

EINE Anekdote
Schilderung einer bemerkenswerten und prägenden Begebenheit

DIE GENESE DES MITEINANDER
und dass mich diese Begebenheit des Miteinander bis heute prägt

Wie vieles im Leben entwickelt sich auch ein Miteinander als Funktion über die Zeit.
In meinem konkreten Fall ist das mit dem Institut und Wulf Schubert eine Stetige, die man in drei Kapitel unterteilen kann.

Kapitel 1 – Der „Herr Professor“
Der erste Kontakt im Rahmen der Grundvorlesung zur Felsmechanik und dem Tunnelbau hat recht rasch den Eindruck hinterlassen, dass es mit dem Herrn Professor Schubert etwas anders wird als vielleicht bis anhin in anderen Vorlesungen. Die Inhalte und die Art und Weise der Herangehensweise and eine Problemlösung waren sehr praktisch orientiert, auch wenn man mit den eigentlichen Inhalten – z.B. die Auswertung von Verschiebungsverläufen im Tunnelbau – zu diesem Zeitpunkt im Studium nicht wirklich was anfangen konnte. Jedenfalls war recht früh klar, dass dieser Herr Professor und auch seine gesamte Institutsmannschaft wussten, wovon sie sprachen, und, vielleicht etwas überraschend, tiefenentspannt und wahnsinnig umgänglich waren.
Kapitel 2 – Der Wulf
Schifahren ist an sich eine schöne Tätigkeit, insbesondere auch dann, wenn man sie mit anderen Aktivitäten in einer Gruppe (von u.a. Felsmechanikern) kombinieren und hierzu die quasi institutseigene Hütte in den Alpen nutzen kann. Man lernt sich in solchem Rahmen nachhaltig besser kennen und baut Hürden des Förmlichen ab. Von nun an ging es, wesentlich näher aneinander, gemeinsam in der Welt des Instituts vorwärts. Und dazu zählen auch eine beträchtliche Anzahl an Reisen zu Fachkonferenzen. Es war viel Spaß dabei, eingebettet in harte inhaltliche und zeitlich umfangreiche Arbeit.
Kapitel 3 – Ein Freund und Mentor
Irgendwann, man merkt es kaum, ist das Miteinander fast selbstverständlich und man versteht sich auch ohne großartige Worte. Auch wenn man räumlich aufgrund der eigenen Entwicklung nicht mehr so nahe ist – die gemeinsamen Erfahrungen sind einem nachhaltig auflch hatte das Vergnügen das Institutsgeschehen über einen längeren Zeitraum in verschiedenen Rollen begleiten und mitgestalten zu dürfen. Das war eine großartige Zeit mit viel Arbeit und Spaß.

Herzliche Gratulation dem Institut zum 30. Jubiläum und insbesondere Wulf Schubert ein herzliches Danke für sein Wirken.

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30 Years of RMT

Statements by Wulf Schubert's former assistants 5/7[1]

Michael Henzinger
From 2013 to 2018 at the institute.

Die Schubert‘sche Konstante

Mit folgenden Worten soll eine der gesprächigsten, herzlichsten und unterhaltsamsten Seiten des ohnehin freundlichen Wulf gewürdigt werden. Den meisten, wenn nicht allen ehemaligen Mitarbeitern des Instituts ist diese ein Begriff. Benennt man diese Seite, muss sie wohl Lisl Schubert heißen.
Lisl Schubert ist eine Konstante, die das Institut seit der Entstehung ständig begleitet. Stets hat sie uns Assistenten und Mitarbeitern in schwierigen Situationen ihr Ohr geschenkt. Bei den Skiwochenenden in Obertauern war sie stets dabei. Dem einen oder anderen wurde dort das Skifahren beigebracht. Nach einem langen Schitag verwöhnte sie uns stets mit Kasspatzln.

Da Lisl regelmäßig bei Fachtagungen teilnahm, begleitete sie uns auch 2016 ins schöne Kappadokien in der Türkei. Während Wulf an etlichen Board Meetings teilnehmen durfte, begleitete Lisl uns auf der Rundtour durch die beeindruckende Felslandschaft. Hierbei stellte sich heraus, dass Lisl nicht nur über Ortskenntnisse verfügt, sondern auch mit fundierten Türkischkenntnissen auftrumpfen kann. Zum Glück wusste Lisl außerdem, wo man sich nach einer kräftezehrenden Besichtigung der kappadokischen Höhlenarchitektur mit ausgezeichneter türkischer Küche stärkt. Unweigerlich verbunden mit dem Institut für Felsmechanik und Tunnelbau und dem Doktorvater ist Lisl Schubert, der Anker im Fels.
Danke, Lisl!

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30 Years of RMT

Statements by Wulf Schubert's former assistants 6/7[1]

Peter Johann Sellner
From 1997 to 2000 at the institute.

Wie ich zum Tunnelbau kam

Ungefähr in meinem 5. Semester stand ich im Oktober 1993 vor der Quästur der TU Graz im Gebäude der Alten Technik in der Rechbauerstraße und las dort am Aushangkasten die möglichen Vertiefungsrichtungen des Bauingenieurwesens. Internet gab es noch keines und so musste ich mir die Inhalte der einzelnen Studienrichtungen aus dem jeweiligen Vorlesungsverzeichnis (Studienführer) bzw. aus den Schaukästen der einzelnen Institute herauslesen und aus Gesprächen mit Institutsangehörigen oder Studenten ableiten. Alles konstruktive und verkehrstechnische schied irgendwie aus – „*ich kam ja vom Gymnasium*“ – und so blieb nur mehr „Geotechnik und Wasserbau“ als Vertiefung übrig. Vor den Schaukästen der Institute für Felsmechanik und Tunnelbau sowie Bodenmechanik und Grundbau stehend versuchten daher ein Studienkollege und ich, uns entweder in Richtung Felsmechanik oder Bodenmechanik zu orientieren. In einem Schaukasten lasen wir die Vorlesung „Grundlagen der NATM“ und – zugegeben – damals konnte ich mit dem Wort „NATM“ überhaupt nichts anfangen und das erweckte reges Interesse, um was es da geht. Der Neugierde folgend saßen wir bald darauf bei Wulf Schubert in der Vorlesung und erfuhren, dass es hier um eine österreichische Methode geht, mit der Tunnels gebaut werden können.

Auffällig war bald einmal, dass doch einiges der NATM auf Hausverstand und nicht vieles auf Normen beruht. Einiges beruhte auch auf ganz einfachen technischen und physikalischen Grundlagen. Dem Zufolge war damit zu rechnen, dass sich das „Strebern“ für Prüfungen auf Aktivieren des Hausverstandes und Anwendung einfacher technischer Überlegungen fokussieren wird, was uns mit weniger Aufwand verbunden erschien, als viel Theorie zu büffeln. Dies war vermutlich der Grund meines Verbleibens bei der Studienrichtung Geotechnik und Tunnelbau bis zur Dissertation. Auf diesem Weg wurde mein Hausverstand durchgehend stark beansprucht. Wulf Schubert hat da nicht locker gelassen und uns dazu immer motiviert. Mittels sogenannten „Sauschneiderrechnungen“ und interessanten Simplifikationen bastelten wir uns die Antworten auf komplexe Themen und Fragestellungen. Im Ergebnis waren die Lösungen zumeist erfolgreich.
Dass ich dann am beruflichen Wege doch einiges an Theorie lernen musste – hauptsächlich in den Tunnelbau begleitenden Fachbereichen – steht außer Streit. Den Hausverstand zu aktivieren und Komplexes zu simplifizieren ist aber auch in diesen Disziplinen immer noch wichtiger denn je und ein hoffentlich noch lange verfügbares erfolgreiches Lösungswerkzeug aus der Schule von Wulf Schubert.

Dafür ein herzliches Dankeschön und Glück Auf!

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30 Years of RMT

Statements by Wulf Schubert's former assistants 7/7[1]

Markus Pötsch
From 2004 to 2007 at the institute.

Wieviel Englisch ist genug? Eine kurze Anekdote über die Erfahrung sprachlicher Herausforderungen im wissenschaftlichen Diskurs

Internationale Fachkonferenzen dienen der Präsentation und dem Austausch des wissenschaftlichen Fortschritts. Englisch als Konferenzsprache, mit der die Teilnehmer vom Institut (stehend im Bild oben) recht gut vertraut waren, versteht sich dabei von selbst. Eine Serie an Ereignissen im Zusammenhang mit Hrn. Alan Thompson (im Bild oben erster von rechts) aus Westaustralien zeigte uns jedoch die Grenzen unseres sprachlichen Vermögens aus. Wir lernten Hrn. Thompson im Rahmen der Felsmechanik-Konferenzen in Lissabon bzw. San Francisco als eine überaus freundliche, kompetente und kommunikative Person kennen - aber auch als eine wahnsinnig schwer zu verstehende. Das war vermutlich dem ausgeprägten ruralen westaustralischen Akzent geschuldet.

Ein paar - im Nachhinein lustig anmutende - Beispiele möchten das dem Leser verdeutlichen:

1. Gespräch während des Abendessen. Monolog Alan Thompson. Inhalt unbekannt. Plötzlich lässt die Satzmelodie auf eine Frage schließen. Panik. Andreas: “Markus, what do you think about that?”. Noch mehr Panik. Markus: “I fully agree.”
2. Ungläubiges Knurren von Alan leitet den zweiten Teil des Monologs ein.
3. Wieder Abendessen, anderer Ort. Alan Thompson im Gespräch mit Wulf. Wulf gibt Zustimmung und Interesse vor. Nach geraumer Zeit erklärt auch Wulf mit den Worten “Do muasst owa guat banond sein, wonnst bei dem wos verstehn wüst” seine Grenzerfahrung.
4. Konferenzvortrag Wulf. Fragerunde. Alan stellt eine Frage im bereits bekannten, jedoch nicht vertrauten Akzent. Wulf gibt per Handzeichen zu verstehen, dass die Frage nicht angekommen ist. Freundlicherweise wiederholt Alan die Frage, jedoch nicht deutlicher, sondern schlicht und ergreifend lauter.

Der Inhalt der Frage zuletzt konnte mit Hilfe des Auditoriums geklärt werden, jener der abendlichen Gespräche blieb unbekannt.

Abschließend gratuliere ich dem Institut für Felsmechanik und Tunnelbau herzlich zum dreißigjährigen Bestehen und wünsche alles Gute und viel Erfolg für die Zukunft.

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30 Years of RMT

Statement by Thomas Marcher's former assistant[1]

Georg Erharter
From 2018 till today at the institute.

Dissertation der Kontraste

Anlässlich der 30 Jahre Feier des Instituts für Felsmechanik und Tunnelbau der TU Graz, wurden ehemalige Dissertanten des Instituts zum Beitrag einer "Anekdote aus der Dissertationszeit„ aufgerufen. Für einen verhältnismäßig "frisch" abgeschlossenen, kann sich diese vermeintlich triviale Aufgabe jedoch als herausfordernd entpuppen, wenn 2/3 der Dissertation während einer Pandemie stattgefunden haben. Die Möglichkeiten zum Erleben von erzählenswerten "Dissertations Anekdoten" während monatelangem Home-Office sind ja doch leider sehr begrenzt und das Schaffen sehr auf das Sachliche konzentriert.

Demnach soll die Erzählung an dieser Stelle einen Überblick über das erste, erlebnisreiche "preCovid" Drittel der Dissertation stehen, welches in scharfem Kontrast zum Rest steht. Als erster Dissertant, des neuen Prof. Thomas Marcher, war die Anfangszeit der Dissertation durch Reisen und exzessives Networking geprägt. Prof. Marcher sah es als seine Hauptaufgabe dem neuen Dissertanten ein möglichst breites Netzwerk an Partnern aus der universitären und angewandten Welt zu eröffnen. So wurden im Zuge dessen insgesamt 34 Dienstreisen und Besuche innerhalb eines Zeitraums von weniger als 1.5 Jahren zu verschiedensten Firmen und Universitäten angetreten! Im Schnitt alle zwei Wochen eine neue Organisation besuchend, wurden so z.B. die University of Leeds oder ARUP in Großbritannien, das Norwegian Geotechnical Institute in Oslo oder Guimarães (die Wiege Portugals) abgeklappert, um neue Kontakte zu knüpfen.
Zwei Jahre Pandemie mit exzessiven Online-Meetings später und in einer Zeit von (nicht ungerechtfertigtem,) klimabedingtem "Flight Shaming" mag diese Reisekultur zu Forschungszwecken absonderlich erscheinen. Dennoch war diese Zeit rückblickend betrachtet einmalig, soll nicht bereut, aber vermisst werden und bereitete den Nährboden für viele fantastische Entwicklungen, welche andernfalls nicht stattgefunden hätten.
Es mögen noch viele Dissertanten ähnliche Erlebnisse machen können und ihr Netzwerk von Graz aus in die ganze Welt spannen können!

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30 Years of RMT

30 Years Institute of Rock Mechanics and Tunnelling & Saint Barbara's Day Celebration

On December 2nd 2022, the Institute of Rock Mechanics and Tunnelling celebrated its 30th anniversary. It was well attended with 150 persons. After a short welcome by Prof. Thomas Marcher, Dean Prof. Martin Schanz opened the celebrations with a short speech recalling the founding situation of the Institute.
Subsequently, founder and former institute head Em.Prof. Wulf Schubert looked back at his start and his 26 years at the institute. He acknowledged the numerous achievements in research, of which many have found its way into practice, the theses, which were written in this time and the multiple collaborations in many projects. Despite of all of these successes, Em.Prof. Wulf Schubert mentioned that for him the best of this time are the numerous friendships, which developed in these years and often lead to further collaborations.

Prof. Thomas Marcher, who leads the institute since October 2018, continued the celebration. He recaptured the last four years and summarized the new research focus of the institute, which has been built up so far and will be built up further. Prof. Thomas Marcher is very much looking forward to the years ahead.
Subsequently, under the humorous moderation of Dr. Nedim Radoncic, eight former doctoral students contributed to the celebration with anecdotes of their time at the institute. The contributions were well received and often lead to bursts of laughter. The anecdotes show the team spirit at this institute during the past decades and on top deliver some lections, which can be applied in everyday life. As part of a university, we see it as our duty to spread knowledge and hence, provide free access to those lections by sharing the video of the celebration on the video portal of the Graz University of Technology. The musical accompaniment of the band "All Jazz Ambassadors" rounded off the festival setting.
The evening then continued with the traditional Saint Barbara's Day celebration of the Institute of Rock Mechanics and Tunnelling. It was a pleasure to welcome so many persons to it and celebrate until the morning together. We thank our sponsors for making that possible.

All in all, the two celebrations were a big success and brought together many persons. We thank again all contributors and hope that we can celebrate many more anniversaries of the Institute of Rock Mechanics and Tunnelling together.

Glück auf!

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30 Years of RMT

30th anniversary celebration and annual St. Barbara gathering - Photo section

Lecturer: Univ.-Prof. Dr.-Ing. Martin Schanz

Lecturer: Univ.-Prof. Dr.-Ing. Martin Schanz

Lecturer: Ass.Prof. Dipl.-Ing. Dr.techn. Manfred Blümel

30 Years of RMT

30th anniversary celebration and annual St. Barbara gathering - Photo section

Lecturer: Dipl.-Ing. Dr.techn. Andreas Budil

Lecturer: Dipl.-Ing. Dr.techn. Andreas Gaich (right) together with Dipl.-Ing. Dr.techn. Nedim Radončić (right)

30 Years of RMT

30th anniversary celebration and annual St. Barbara gathering - Photo section

Lecturer: Dipl.-Ing. Dr.techn. Karl Grossauer

DDipl.-Ing. Dr.techn. Michael Henzinger handing over of a bouquet of flowers to Elisabeth Schubert

30 Years of RMT

30th anniversary celebration and annual St. Barbara gathering - Photo section

Lecturer: Dr.-techn. Georg Erharter, BSc MSc

Lecturer: Dipl.-Ing. Dr.techn. Nedim Radončić

30 Years of RMT

30th anniversary celebration and annual St. Barbara gathering - Photo section

Lecturer: Em.Univ.-Prof. Dipl.-Ing. Dr.mont. Wulf Schubert

Lecturer: Dipl.-Ing. Dr.techn. Markus Pötsch

30 Years of RMT

30th anniversary celebration and annual St. Barbara gathering - Photo section

Lecturer: Univ.-Prof. Dipl.-Ing. Dr.-Ing. Thomas Marcher

30 Years of RMT

30th anniversary celebration and annual St. Barbara gathering - Photo section

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30th anniversary celebration and annual St. Barbara gathering - Photo section

30 Years of RMT

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Research Focus

1st Rockfall Symposium Schladming

On the 1st of December 2022 the 1st Rockfall symposium took place in Schladming. The one-day symposium marked the conclusion of the STEIRIS project (STEInschlagRISiko). It was organised by the Graz University of Technology, Institute of Rock Mechanics and Tunnelling, and was fully booked with over 120 participants from German-speaking countries (Germany, South Tyrol, Austria). The topics of the seminar ranged from engineering geology and rock mechanics practice to legal assessment by experts from the University of Graz. From the overview of different approaches of different experts, the metrological monitoring and especially the handling of the natural fluctuation of the input data (rock mechanical parameters) by means of risk management or artificial intelligence was a special focus. In particular, the detection of rockfall risk by image recognition using neural networks was intensively discussed, and possible solutions were identified. In summary, it became clear that IT can do a great deal here, but that rock mechanics expertise remains irreplaceable. Another finding from the expert meeting was the fact that although the rockfall risk is a fracture problem and thus anchored in the rock structure, the concrete trigger is the environmental conditions, in particular the climatic conditions (rain, temperature) and the forestation (windthrow). In particular, dealing with the change in climatic conditions and their direct effects on the rock (freezing-thaw change, heavy precipitation) as well as indirectly via the change in forestation can make it possible to forecast rockfall events.
In summary, there is a high demand for factual information on rockfall, process-oriented monitoring and the need for further research on influencing variables and their quantification.

Figure: Auditorium of the Rockfall Symposium.

Research Focus

1st Rockfall Symposium Schladming – Photo section

Lecturer: Mag. Rainer Kienreich

Lecturer: Dipl.-Ing. Alexander Kluckner

Research Focus

1st Rockfall Symposium Schladming – Photo section

Lecturer: Univ.-Prof. Dr. Walter Doralt

Lecturer: Univ.-Prof. Dipl.-Ing. Dr.-Ing. Thomas Marcher

Research Focus

1st Rockfall Symposium Schladming – Photo section

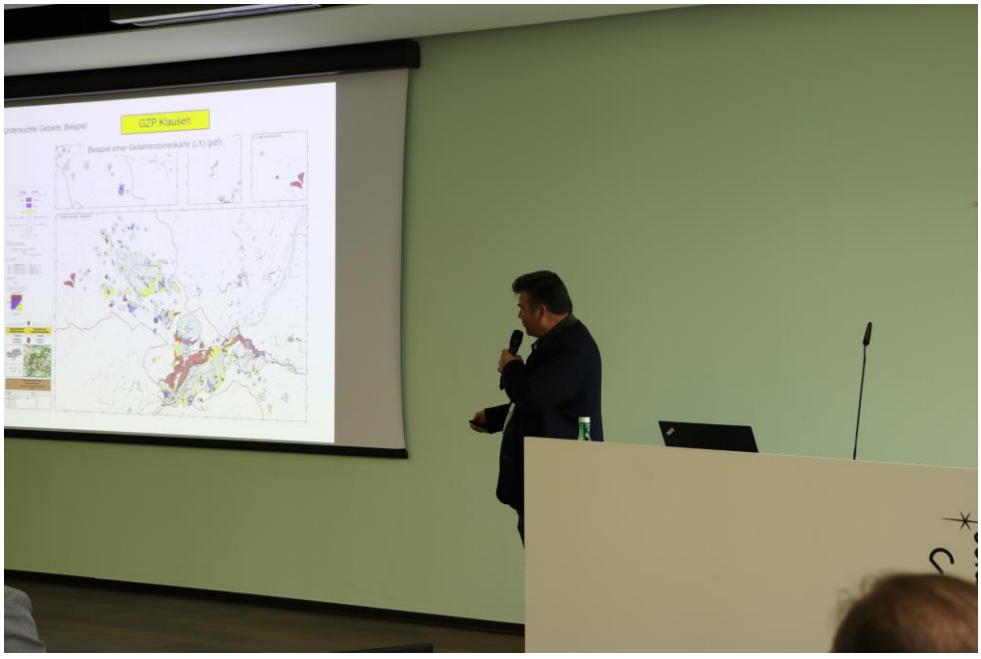
Lecturer: BM Dipl.-Ing. Hermann Trinker

Lecturer: Dr. Eva Stiermayr

Research Focus

1st Rockfall Symposium Schladming – Photo section

Lecturer: Mag. Michael Mölk



Lecturer: Mag. Dr. Volkmar Mair

Research Focus

1st Rockfall Symposium Schladming – Photo section

Lecturer: HR Mag. Gerald Valentin

Lecturer: Dr. Wolfgang Podesser

Research Focus

1st Rockfall Symposium Schladming – Photo section

Lecturer: Dipl.-Ing. Erwin Stampfer

Lecturer: Dipl.-Ing. Georg Unterberger

Research Focus

1st Rockfall Symposium Schladming – Photo section

Lecturer: Univ.-Prof. Dr. Wolfgang Pree

Lecturer: Mag. Alexander Radinger

Research Focus

1st Rockfall Symposium Schladming – Photo section

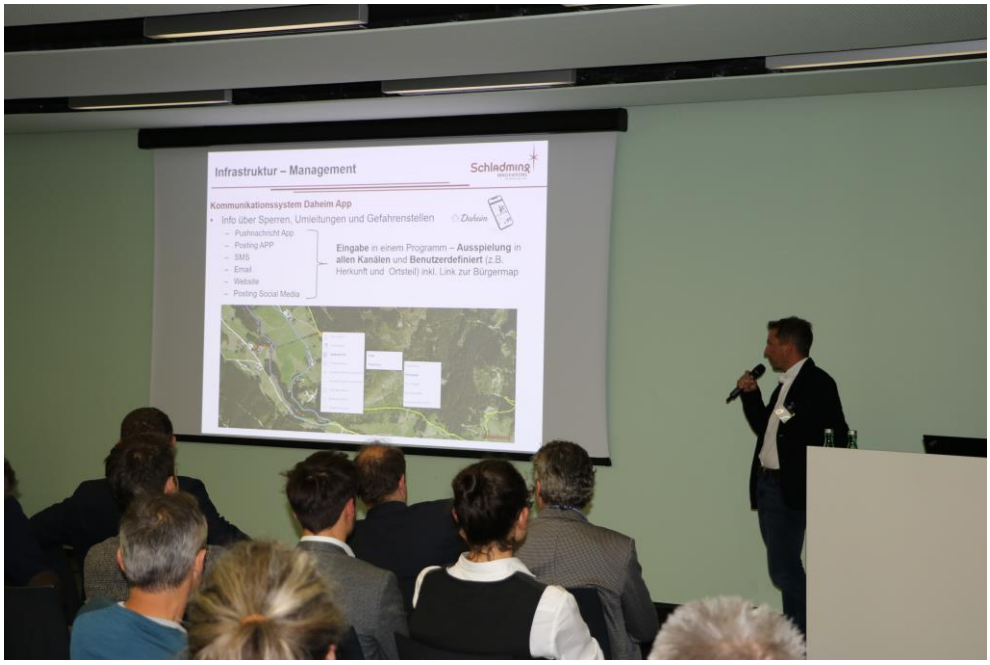
Lecturer: Assoc.Prof. Dipl.-Ing. Dr.techn. Christan Hofstadler (left) & Dipl.-Ing. Dr.techn. Markus Kummer (right)

Lecturer: Univ.-Prof. Dr. Walter Doralt

Research Focus

1st Rockfall Symposium Schladming – Photo section

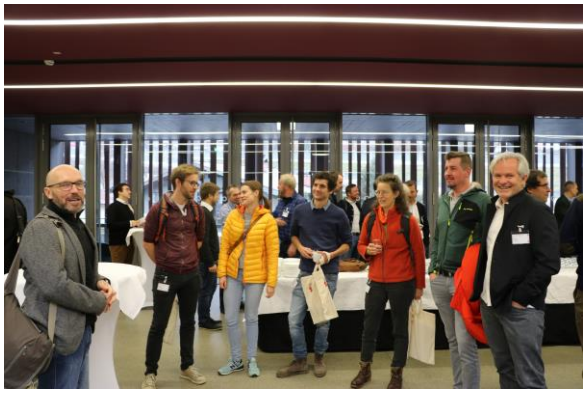
Lecturer: Mag. iur. Florian Greinix



Lecturer: Mag. Johannes Leitner

Research Focus

1st Rockfall Symposium Schladming – Photo section



Research Focus

1st Rockfall Symposium Schladming – Photo section






Research Focus

1st Rockfall Symposium Schladming – Photo section

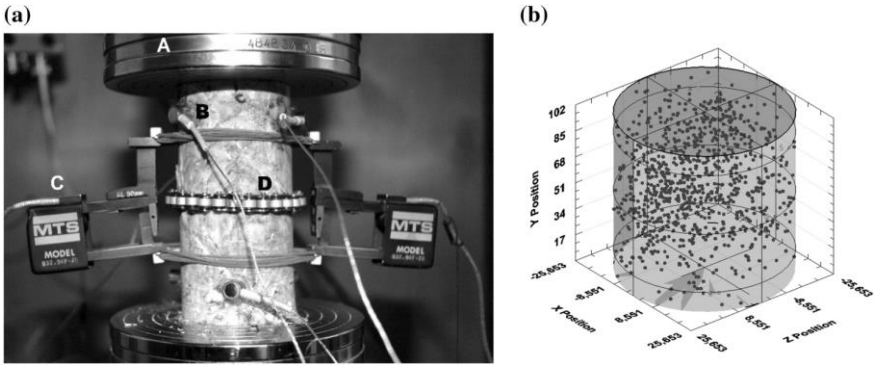
Publications & Presentations I

All publications of the institute are listed chronologically on our homepage. Selected papers and presentations are presented here.

Investigation of the Influence of Grain-Scale Heterogeneity on Strainburst Proneness Using Rock-Like Material

A. Klammer, C. Peintner, L. Gottsbacher, J. Biermann, M. Bluemel, W. Schubert and T. Marcher (Published in Rock Mechanics and Rock Engineering 2022 – Open Access)

As mining and tunnelling projects advance to deeper areas, strainbursts occur more frequently. This failure mode is extremely dangerous, as the rock mass fails abruptly, releasing high amounts of energy. This poses a high risk to the life of workers and equipment used. For a robust strainburst risk assessment many factors have to be taken into account. Besides geological features, overburden, excavation method, etc., rocks' intrinsic proneness to strainburst plays a major role. Whether a rock tends to this failure behaviour depends strongly on the rocks' mechanical and structural characteristics at the grain-level, especially on its heterogeneity. The authors demonstrate this based on different rock-like sample sets, consisting of a very fine-grained fibreless ultra-high-performance concrete (UHPC) and a constant volumetric fraction of coarse aggregates. Thereby the heterogeneity aspect was introduced by the different properties of the aggregates. A laboratory program was performed, taking into account uniaxial compression tests (including post-failure tests to evaluate the failure energy) and Acoustic Emission Testing (to monitor the cracking activity). The study underlines the high suitability of using Acoustic Emission Testing (AET) in strainburst risk assessment. Additionally, the authors analyse empirical parameters commonly used to evaluate rocks' intrinsic proneness to strainburst, and give recommendations regarding their application. Overall, the study substantiates former research and emphasizes the usefulness of petrographic information within strainburst risk analysis. It also sets the base for future research on real rock, which will hopefully lead to more specific recommendations for practitioners on how to include rocks' grain-scale characteristics in strainburst risk analysis



Testing set-up (A = Load Frame; B = AE sensors; C = axial strain gauge; D = circumferential strain gauge) and cumulative display of 3D-location of AE events at about 100 % of uniaxial compressive strength (in this case very uniform distribution)

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Publications & Presentations II

All publications of the institute are listed chronologically on our homepage. Selected papers and presentations are presented here.

A WGAN Approach to Synthetic TBM Data Generation
P. J. Unterlass, G. H. Erharter, A. Sapronova and T. Marcher (Published in Trends on Construction in the Digital Era, A. Gomes Correia, M. Azenha, P. J. S. Cruz, P. Novais, and P. Pereira, Eds. Cham: Springer International Publishing, 2023, pp. 3–19.) - Link

In this work we propose a generative adversarial network (GAN) based approach of generating synthetic geotechnical data for further applications in re-search and education. Geotechnical data generated by GANs shows similar characteristics as the original data, but still presents unique samples with no connection to the technical content of the original data. The data can therefore be made available publicly without any legal issues.

A WGAN (Wasserstein GAN) algorithm is used to generate synthetic tunnel boring machine (TBM) operational data based on real data from a major European tunnel construction site. The demands on the synthetic TBM data are of a dualistic nature: on the one hand, the data has to be sufficiently dissimilar to the original data, so that it does not create confidentiality issues (demand for originality). On the other hand, it has to show the same patterns and follow the same rules as the original data, so that it can be used as if it were real TBM data (demand for conformity). The WGAN model describes how a synthetic dataset is generated, in terms of a probabilistic model based on real data. By sampling from this model, we are able to generate new, unique synthetic and realistic TBM data.

In this work we show that the demands for originality and conformity of the newly generated data are fulfilled.

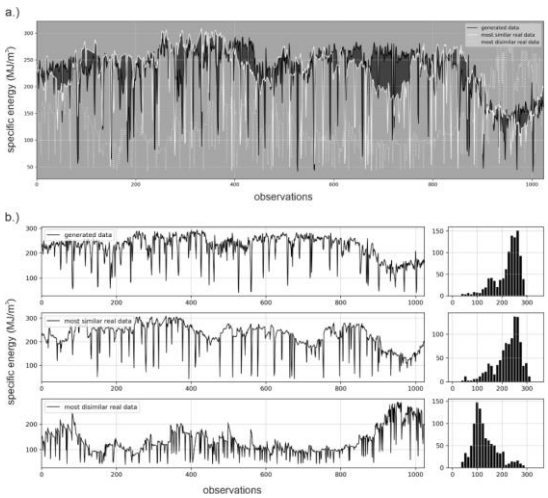

Figure: Synthetic data compared to most similar and most dissimilar real data, where the similarity was determined by the Euclidean distance between every set of synthetic and real data. a.) Synthetic data (black), their most similar (white) and most dissimilar counterpart from real data (dotted white) in one plot and b.) single plots with corresponding data distribution presented in histograms (From Unterlass et. al., 2023).

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Upcoming special sessions I

Special session for ISMLG 2023 (Cork, Ireland)

RMT, together with Mountain University Leoben and Amberg Technology Group, is organizing a special session on "Topic: Data Quality Assurance and Pre-processing in Geoscience" for the 4th International Symposium on Machine Learning & Big Data in Geoscience at University College Cork that will take place in Cork, Ireland from August 29 to September 1, 2023.

The symposium's theme is Data-centric solutions for reshaping the next-generation geo-industries.

Discovering “valid, novel, potentially useful, and ultimately understandable patterns in data” via exploratory analysis in datasets is often referred to as data mining and consists of five main steps: problem identification, data selection, data preprocessing, data analysis, and communication of the results. While the success of data mining depends on the choice of analytical methods, the accuracy of analysis is sensitive to the data quality. The latest is usually addressed during the preprocessing step.

The special session will focus on discussing tools and methods to check and improve the quality of data used in geoscience, including but not limited to discussions on handling sparse, imbalanced, and mislabeled datasets. The session will also offer an overview of the current state-of-the-art followed by practical recommendations on how to perform the data quality assessment while preserving the loss of information necessary for rare events detection.

The section will present:

1. Methods for handling data imbalance and the accuracy of forecasting machine learning models
2. Errors detection in data labeling
3. Extraction of patterns in data during the preprocessing step by applying correlational analysis
4. Manual preprocessing of MWD data
5. Use and limitations on various metrics to assess the quality of extreme sparse datasets

A 2-page abstract can be submitted online at ISMLG Website by December 22, 2022

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Upcoming special sessions II

Special session for IAMG 2023 (Trondheim, Norway)

RMT is organizing a special session on " Rare events detection for risk management in geoengineering" for the 22st Annual Conference of the International Association for Mathematical Geosciences, that will take place in Trondheim, Norway 5-12 August 2023.

The session will address the problem of rare event detection: with a vast amount of collected observations, the events having a significant impact and long-lasting consequences are often the most uncommon in frequency. We propose to discuss tools, methods, and current best practices for rare event detection in geosciences, with a particular focus on risk management and its application in geoengineering. The session will present new proposals and findings from the scientific community that include but are not limited to feature engineering, application of statistical or machine learning methods, and demonstrations of progress in rare event detection that can promote a proactive approach in risk management.

This special section will cover:

1. overviews of methods and recommended workflows for handling data sparsity and uncertainty;
2. reviews of new findings and techniques for rare events' detection and recommendations on data preprocessing methods that help to ensure both data quality and novelty in patterns;
3. reports on how various methods for handling data imbalance affect the accuracy of forecasting data-driven models;
4. approaches used for detecting perceptions and biases in data labeling and interpretations;
5. demonstrations of methods and tools successfully employed for risk modeling and rare event detection.

The follow-up full papers would be recommended for publishing in "Computers & Geosciences" IAMG journal.

Abstract can be submitted online at IAMG Website by February 28th, 2023

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Upcoming special issues

Benchmarks of AI in Geotechnics and Tunnelling

Georg Erharter and Prof. Thomas Marcher currently serve as guest editors for a special issue (SI) under the lead of Prof. Franz Tschuchnigg of the Institute of Soil Mechanics, Foundation Engineering and Computational Geotechnics. The SI is about "Benchmarks of AI in Geotechnics and Tunnelling" for the Journal Geosciences and submissions will be received until 30th June 2023.

Driven by a global trend for digitalization, we have seen an explosion of contributions on artificial intelligence (AI) technologies for geotechnics and engineering geology in the past years. In 2018 we – the editors – founded a working group on “Machine Learning in Geotechnics” at the Graz University of Technology, which continues to closely collaborate with the Norwegian Geotechnical Institute up to the present day. While the developments of AI in geotechnics are in line with global trends, we also see deficits that hinder the general advancement of AI technology in our field. An overwhelming number of contributions can be attributed to the field of supervised machine learning, where algorithms learn input-output relationships based on predefined examples though other fields of AI are underrepresented. Furthermore, there is a significant number of studies that are partly or fully irreproducible due to lacking source code and original data.

With this SI, we wish to provide a platform for high-quality contributions from all fields of AI, including but not limited to supervised machine learning (ML), unsupervised ML, self-supervised ML, reinforcement learning, evolutionary computation, and swarm intelligence. The applied geoscientific context of the contributions is set to be very wide, ranging from fields of geotechnics such as slope stability, constitutive modelling, or tunnelling to all applications of engineering geology such as ground investigations, mapping, or geological modelling.

More information can be found on the website of the SI.

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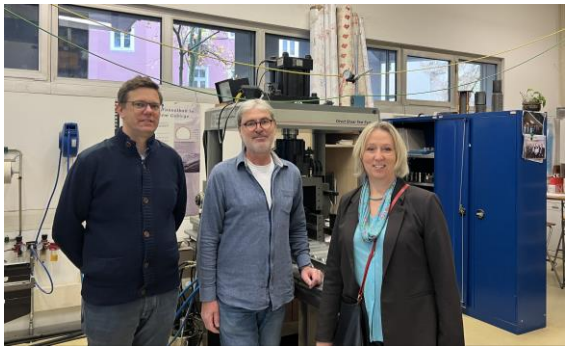
Recent Guests at the RMT

Professor Kristin H. Holmøy (NTNU)

On November 23, Professor Holmøy visited us in Graz. Mrs. Holmøy is a professor at the Norwegian University of Science (NTNU) and Technology and works at the Department of Geoscience and Petroleum. On her way through Austria she also visited our institute. First of all she had a tour through our own laboratory, where she could exchange experiences and expertise with our experts in the laboratory. This was followed by a meeting with all members of the institute to discuss possible joint research activities and collaborations. Furthermore, Professor Holmøy gave us exciting insights into the activities of the Norwegian colleagues and their institute. We are looking forward to further activities with Professor Kristin H. Holmøy.



Dipl.-Geol. Dr. Jörn Wichert & Dipl.-Geol. Peter Dommaschk

The day after the symposium on rock fall (Steinschlag-Symposium) we were very pleased to welcome two experts from Germany as guests at our institute. Dipl.-Geol. Dr. Jörn Wichert is a senior researcher at the TU Bergakademie Freiberg where he has many years of experience in rock stability research. He has headed several research projects focusing on various aspects of geo-risks in a national as well as an international frame. Dipl.-Geol. Peter Dommaschk serves as deputy head of the engineering-geological department at the geological survey of the Free State of Saxony. He has a vast experience in rock stability challenges and thereby induced risks as well as the mitigation measures initiated by those responsible in administration as well as public authorities.

On December 1st Mr. Wichert and Mr. Dommaschk attended the symposium on rock fall held in Schladming and contributed to the scientific discussions there. On the following day both of them travelled to Graz to follow up with several meetings on future cooperation possibilities. After a visit of the Institute's laboratory our German guests explained their research and professional activities as well as future topics to an interested audience at our institute. Several links to the work done at the RMT-Institute have been identified and a work schedule has been set up to apply for funding for a joint bilateral research project. At the end of a fruitful day we were pleased to welcome our German colleagues to the 30 years birthday celebration of our institute in the aula of the university.

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Teaching I

Joint Privatissimum with the Institute for Soil Mechanics, Foundation Engineering and Computational Geotechnics

For the first time in two years, it has been possible to jointly hold a Privatissimum with the neighboring Institute of Soil Mechanics, Foundation Engineering and Computational Geotechnics. In the last two years, this annual exchange of expertise was cancelled for well-known reasons. Fortunately, this year it was possible again. Thus, this event took us to a seminar hotel on the Reinischkogel in Styria from November 7th to 9th.

During the Privatissimum, each doctoral student of both institutes had the opportunity to present his research activities as well as their progress to the professors and colleagues. These presentations led, not surprisingly, to exciting (and sometimes lengthy) discussions. From these debates, further exciting research questions as well as approaches to solving potential problems could be identified. These questions and inputs can be processed and answered until the next years Privatissimum.

In addition to the exciting scientific discussions, the social component was of course not neglected. During the common meals and various cold drinks, existing contacts could be cultivated and new ones established.

The RMT is already looking forward to the fascinating technical and scientific discussions at the annual Privatissimum next year!

Figure: Group photo of the two institutes.

Teaching II

Winter School #1
TU Graz – Ostschweizer Fachhochschule

The Inter-Institutional Agreement 2022 - 2027 within the framework of the "Swiss-European Mobility Program SEMP" for the partnership for mobility between TU Graz and FH OST was initiated by our institute RMT and Prof. C. Rabaiotti (Geotechnics, FH OST). On this basis, an intensive exchange programme can start. This will start with a "Short-Summer- and Winterschool" which will be held alternately in Graz and Rapperswil (CH).

The first "Short Winter School" will be held on 2 and 3 February at Graz University of Technology (hybrid transfer to Rapperswil) and is aimed at all interested students at the end of their Bachelor's or within Master's degree in civil engineering. Corresponding ECTS points will be credited.

2 February 2023 is themed "Introduction to Structural Maintenance of Reinforced Concrete Buildings". In the morning, Prof. Felix Wenk (OST) will give an introduction to condition assessment of reinforced concrete structures with a focus on damage mechanisms and reinforcement corrosion, as well as condition assessment of reinforced concrete structures and condition assessments. In the afternoon, Prof. Dr. Ivan Markovic (OST) will give a lecture on the verification of the structural safety of an existing reinforced concrete road bridge including structure-soil interaction with a focus on the concept for static modelling of the bridge, plausibility check of the main internal forces. Furthermore, selected verifications of the structural safety and influence of settlements on the structural safety.

The 2nd part (3 February), given by Antonio Salazar Vásquez (OST), MSc Geotechnical Engineering, focuses in the morning on the theory of fibre optic sensing and general applications, field applications and laboratory applications. The afternoon block (interactive in our rock mechanics lab) includes introduction to interrogation and splicing techniques, data acquisition using Python and testing a sample, and post-processing the data using Python.

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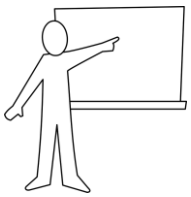
Faces

Mag. Rainer Kienreich – PhD student

Allow me to introduce myself : Rainer Kienreich, I am a native of Styria from Knittelfeld, born in 1968. I completed my "first" period of study at the Institute of Engineering Geology at Graz University of Technology under Prof. Riedmüller in 1992. My diploma thesis was on the engineering geological forecast for the Semmering Base Tunnel. Professionally, I worked for several years as a geologist for the province of Styria. Later I was project manager for the second tube of the Plabutsch Tunnel near Graz and the Herzogberg Tunnel on the Styrian Pack. The next professional station was Autobahnen- und Schnellstraßen-Finanzierungs Aktiengesellschaft (ASFINAG), where I went through the classic management career. Most recently, I was allowed to work in the Austria-wide operating company (ASFINAG Service GmbH) nearly 10 years as managing director. Since the beginning of 2019, I have returned to Styria as head of the Liezen construction district management, the technical administrative unit next to the responsible district administration, and I will take up this position in Graz at the beginning of 2023. I learned from my alma mater, Graz University of Technology, that a sound technical education is the key to a future career. I have always followed this principle, whether in qualifying as a civil engineer or as a court expert. Since the summer semester of 2021, I have been able to start again with my "second" period of study as a doctoral student at the Institute for Rock Mechanics and Tunnelling at TU Graz under Prof. Marcher. I am working on the rockfall risk, which is of particular importance due to the influence of climate extremes. In a first stage, we were able to complete the STEIRIS project together with colleagues from the institute. Now I am going to work on my dissertation entitled "Rockfall Risk: Modular Risk Management System". I have already been fascinated by the collegiality, helpfulness and professional support at the institute. I am very happy to be part of this team!

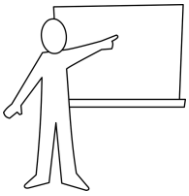
Diary of Events

> Lecture „Die Herausforderungen an den landesgeologischen Dienst - Fallbeispiele aus Kärnten“ (in German)
Graz, Austria (2023/01/26, 17:15 CET)



Lecture by the federal geologist of the province of Carinthia Mag. Franz Goldschmidt. The lecture will be in German and will take place in the lecture Room HS L (Lessingstraße 25/1, 8010 Graz). Registration via email addressed to tunnel@tugraz.at .

> Lecture „Grossprojekt im Energiesektor, Kraftwerk Linth-Limmern Bau eines 1'000 Megawatt Pumpspeicherkraftwerkes im Schweizer Hochgebirge Leistungsstarke Logistikkonzepte und nachhaltige Materialbewirtschaftung“ (in German)
Graz, Austria (2023/04/27, 17:15 CET)



Lecture by Dipl.- Ing. Bernd Raderbauer EMBA of the Marti Tunnel AG. The lecture will be in German and will take place in the lecture Room HS L (Lessingstraße 25/1, 8010 Graz) . Registration via email addressed to tunnel@tugraz.at .

> ATC²-Symposium 2023 RMT followed by “Barbarafeier”
Graz, Austria (2023/12/01)

Symposium by the Austrian platform ATC² (Austrian Tunnel Competence Center), a collaboration of Graz University of Technology and Montanuniversität Leoben. The aim of the symposium is to transfer innovative ideas and know-how in tunnelling. In English. The topics of the upcoming events are: Shallow Tunnelling, Urban Tunnelling incl. Metro Tunnels and Stations. Further information can be found on the ATC² homepage.
After the ATC²-Symposium our yearly “Barbarafeier” will take place.

ATC² Austrian Tunnel Competence Center
Graz University of Technology | Montanuniversität Leoben

If you are interested in submitting an abstract, please send it to Ms. Ines Metzler MSc (metzler@tugraz.at) till 2023/02/28.
http://austrian-tunnel-competence-center.at

> ATC²-Symposium 2024
Innsbruck, Austria (2024/11/14)

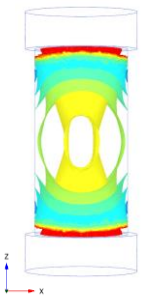
Symposium by the Austrian platform ATC² (Austrian Tunnel Competence Center), a collaboration of Graz University of Technology and Montanuniversität Leoben. The aim of the symposium is to transfer innovative ideas and know-how in tunnelling. In English. In 2024, ATC² will be hosted at the guest location in the City of Innsbruck. Information on the topics of this event will follow. http://austrian-tunnel-competence-center.at

ATC² Austrian Tunnel Competence Center
Graz University of Technology | Montanuniversität Leoben

>“Barbarafeier” 2024
Graz, Austria (2024/11/29)
More information will follow. Save the date.

Have a look at our Master‘s Theses I

The institute has different research areas and offers numerous topics for a master thesis.

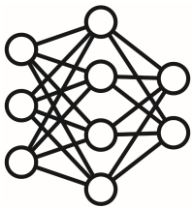


- **Numerical and experimental investigation of rock anisotropy**

(supervisors: T. Frühwirt, M. Winkler)

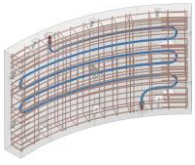
Rock is a complicated material, for example it is very often anisotropic making its’ deformational and strength characteristics dependent on the loading direction. To learn more about this phenomenon, numerical and experimental studies need to be carried out.

- **Machine Learning (supervisor: G. Erharter, P. Unterlass)**



An exciting area of research is being led by the newly founded Machine Learning in Geotechnics (MLGT) Group. The research of this group focuses on machine learning, but the research topics are quite diverse, as one thesis deals with the application of Artificial Neural Networks (ANN) for the prediction of high resolution landslide monitoring data and another with the analysis and evaluation of geophysical data from Tunnel Seismic Points (TSP).

- **Tunnel-thermal energy (supervisor: T. Geisler)**



Moormann, C. (2010). GeoTU6 – a geothermal Research Project for Tunnels. Tunnel. 29. 14-21

You are interested in geology, tunnel construction and alternative forms of energy production? If so, this topic could be interesting for you. The main goal is the extraction of geothermal energy, by using (infrastructure) constructions, with the focus on deep-seated tunnels, so called “tunnel thermal energy”. This requires a symbiosis of geology, technical implementation possibilities and tunnel construction.

- **Significance of thermomechanical processes on rockfall hazards (supervisor: R. Kienreich)**

© Rainer Kiernreich

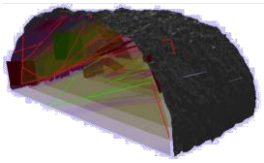
Thermomechanical processes, along with interface structure and mountain water conditions, are considered primary triggers of rockfall phenomena. The rock mechanical hypothesis is that numerous microcracks form more or less statistically distributed cavities. In the precipitation-intensive period in the following fall, this causes intensive water input, which leads to an increased exceeding of the stability, i.e. rockfall. In order to get a better understanding of the phenomenon, the field data - precipitation in combination with the temperature course of the accumulation of rockfall events should be compared. The different material behavior of carbonate and crystalline rocks is to be described from literature data or possibly laboratory tests.

Have a look at our Master‘s Theses II

- **Data Science in Geotechnics** (supervisor: A. Sapronova)

Advances in engineering equipment that is now capable to delivers massive in-situ data at runtime, open the possibility of employing data analysis and data-driven modeling to ensure proactive risk management and optimize the work. Although a large number of features characterize the geotechnical data, its extreme volumes and sparsity place special constraints on the applications of the data science methods in geoengineering and the special focus shall be placed on the data quality assessment, pre-processing routines, and integration of the data from various sources.

- **Digital Face (supervisor: A. Sapronova)**

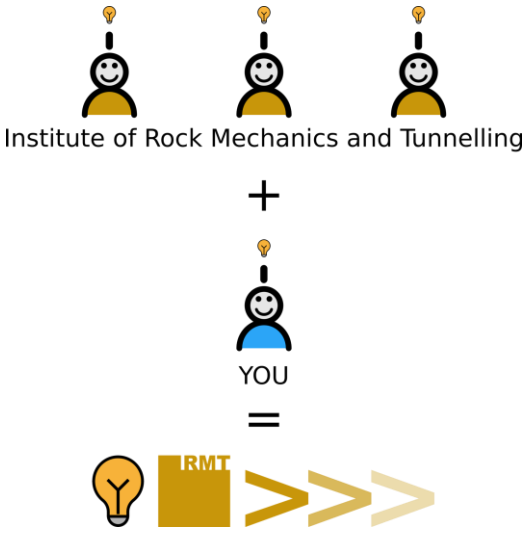


Various data near and at the tunnel face is available during the underground construction: from hand-made technical sketches made by geologists to the 3D point-cloud datasets from seismic surveys. Integration of such information into a harmonized database that will help to forecast the geological conditions and ensure safe tunneling. Ongoing research aims to find methods for the information extraction and integration to move further from the survey data to the dynamically updated visual and digital representation of a tunnel face.

- **Aspects of steel – rock contacts in TBM tunneling (supervisor: G. Erharter)**

New contractual developments set a focus on the effect of shield friction in hardrock TBM tunneling. Low speed and low stress contacts between steel and rock have not been explored a lot so far and the goal of this study is to focus on geometrical and mineralogical aspects of contact points between tunnel boring machine (TBM) shields and the tunnel wall. Research questions that need to be answered are for example: What are the contact points between a TBM shield and the tunnel wall in slanting and curved driving conditions? Which mode of TBM driving is most unfavorable in terms of expected frictional resistance? Are there correlations to standard abrasivity tests such as the Cerchar abrasivity? Methodologically the thesis should contain theoretical work, analog models, and geotechnical laboratory work (abrasivity tests). The master thesis is part of a currently ongoing bigge rresearch endeavor on this matter.

Positions at RMT



Open Positions

- We are looking for a technician with interest in mechanical and electrical engineering to support our laboratory team. The job offers plenty of variety as it includes diverse tasks ranging from operating high-end measuring equipment to skilled manual work such as drilling and sawing of rock cores. A special focus will be on mechatronic and electrical engineering to set-up, retrofit and further develop our laboratory testing equipment. This challenging full-time job may be started before the end of this year, the sooner the better. For more information just send us your contact details via tunnel@tugraz.at.

JOIN RMT – we'd love to welcome you.

Cooperation

… please contact us in case we forgot you here

© Lunghammer (TU Graz)

Unfortunately missing in this picture: Manfred Blümel, Alexander Kluckner, Rainer Kienreich, Vaibhav Shringi, Timna Plöchl and Alla Sapronova.

… moving forward