Gysbert Basson – ITASCA Australia

Numerical Modeller, Software Engineer and Seismologist

Expertise

Numerical Modelling (Boundary Element Method, Discrete Element Method, Finite Element Method, Material Point Method, Seismic Source Kinematic Modelling), software developer, mine seismologist, mathematical modelling, seismic waveform processing, machine learning models, hydraulic fracturing for preconditioning in mining, seismic hazard analysis, mine re-entry, trigger action and response plan, seismic source mechanism analysis)

Education

Doctor of Philosophy (Applied Mathematics), 2022
University of Tasmania, Hobart, Tasmania, Australia

Master of Bachelor of Science (Applied Mathematics), 2011
University of Stellenbosch, Stellenbosch, Western Cape, South Africa

Honours of Bachelor of Science (Applied Mathematics), 2007
University of Stellenbosch, Stellenbosch, Western Cape, South Africa

Bachelor of Science (Mathematical Sciences), 2006
University of Stellenbosch, Stellenbosch, Western Cape, South Africa

Professional Experience

2023 – Present	ITASCA Australia Pty Ltd, Hobart, TAS, Australia Numerical Modeller, Seismologist and Software Engineer
2010 – 2022	Institute of Mine Seismology, Kingston, TAS, Australia Seismologist, Software Developer and Numerical Modelling Expert in Mining
2007 – 2010	ISS International, Stellenbosch, Western Cape, South Africa Seismologist, Software Developer and Numerical Modelling Expert in Mining

Project Experience

(2018 – 2022) PhD dissertation:

The project makes 4 major contributions to numerical simulation for mining applications. First, a new numerical solver known as the Material Point Method (MPM) is modified to address quasi-static mining related problems. With this, a new meshing technique is developed for the MPM (also applies to FLAC3D) such that it can be used to simulate models of large mining layouts. Second, a method is developed to extract seismic events from elasto-plastic regions in the model. Third, an algorithm of the coupled MPM is proposed to handle problems of fluid- and solid mixtures in mediums with heterogeneous permeability. Fourth, a new method for handling fractures as well as fracture propagation is proposed. This is used to simulate hydraulic fracturing preconditioning in mining where a dense fracture network is created within a small volume of rock such that stress is redistributed away from the area and becomes less seismically hazardous. These additions to numerical modelling in mining allows for addressing a wide range of problems, all with the goal to have better control over mining-induced seismicity.

(2007-2022) Research and Development of Numerical Solvers for Deep Underground Mining:

Researched and implemented various numerical simulation techniques, namely the Boundary Element Method, Finite Element Method, Discrete Element Method and Material Point Method, to research and address various mining related problems. These tools were successfully used in numerous mining projects to address a diverse set of problems.

(2010 – 2022) Research, Development and Application of Micro -Seismic Analysis Software for Mining:

Developed micro-seismic software for mining; large event analysis, seismic hazard assessment, seismic waveform processing, blast re-entry analysis, trigger-action-and-response-plan, seismic ground motion analysis, CAD, routine seismic reporting.

(2021) Machine Learning Models for Classifying Seismic Waveforms:

Researched and implemented various supervised machine learning methods to classify raw seismic waveforms recorded from a mine's seismic systems.

Papers and Publications

Basson, G.: An explicit finite difference method for analysing hazardous rock mass. MSc thesis, University of Stellenbosch (2011).

Basson, G.: A Material Point Method to simulate macro-scale problems in mining. PhD thesis, University of Tasmania (2022).

Basson, G., Bassom, A.P., Salmon, B.: Simulating hydraulic fracturing preconditioning in mines with the material point method. Journal of Applied Geophysics 195, 104471 (2021).

Basson, G., Bassom, A.P., Salmon, B.: Simulating mining-induced seismicity using the material point method. Rock Mechanics and Rock Engineering 54(6), 4483–4503 (2021).

Basson, G., Bassom, A.P., Salmon, B.: A flux-based approximation to simulate coupled hydromechanical problems for mines with heterogeneous rock types using the material point method. Computer Modeling in Engineering and Sciences 131(1), 379–409 (2022).

Malovichko, D., **Basson**, G.: Simulation of mining induced seismicity using Salamon–Linkov method. Proceedings of the Seventh International Conference on Deep and High Stress Mining (eds. M Hudyma & Y Potvin), Australian Centre for Geomechanics, Perth (2014).

Meyer, S., Doolan, J., Chester C., **Basson**, G.: Rapid assessment of the spatial extent of strong ground motion in mines – ShakeMap approach. Fourth International Symposium on Block and Sublevel Caving, Canada (2018).

Chester, C., Cuello D., **Basson** G.: Development and implementation of the Short Term Activity Tracker and Mine Control Trigger Response System. 521-532. Fourth International Symposium on Block and Sublevel Caving, Canada (2018).