Journal of Powder Metallurgy & Mining

ISSN: 2168-9806

Xu, J Powder Metall Min 2022, 11:4

Perspective | Open Access

An Approach for Finite Difference Modeling of Mining that is Geometrically and Spatially Adaptable

Nengxiong Xu*

School of Engineering and Technology, China University of Geosciences (Beijing), Beijing, 100083, China

Perspective

Introduction

Underground mining-induced surface subsidence is a common hazardous geohazard. To predict and assess mining-induced surface subsidence, numerical techniques such as the discrete element method (DEM) and the finite difference method (FDM) have been frequently employed. The DEM, on the other hand, is often computationally expensive and incapable of assessing large-scale problems, whereas mesh distortion can arise in FDM modelling of heavily distorted surface subsidence. To address the issues raised above, this work proposes a geometrically and locally adaptive remeshing method for FDM modeling of heavily distorted surface subsidence caused by subterranean mining. Coal seam mining can induce surface deformation and overburden movement, as well as a variety of geohazards such overburden fracture, surface cracks, landslides, and surface subsidence. The profile function, influence function, and numerical modelling are all methods for evaluating and predicting surface subsidence.

Adaptive remeshing of the deformed mesh, as previously mentioned, is an excellent approach for dealing with mesh distortion in FEM or FDM modeling [1-5]. To the authors' knowledge, practically all relevant work focuses on adaptive remeshing for distorted meshes with only one attribute, without taking into account concurrent remeshing for distorted meshes with multiple characteristics.

Description

The proposed adaptive remeshing method's process

Depicts a simplified procedure of the proposed geometrically and locally adaptable remeshing approach. The deformed mesh is chosen in the iterative calculation by continuously judging the mesh's quality, and then the distorted area is calculated. The warped area's tetrahedral meshes are remeshed, and the new meshes are joined with the existing mesh. The main goal is to find, delete, and regenerate deformed meshes in FDM models of mining-induced surface subsidence**.**

Creating a warped space

When the distorted mesh has been discovered, it is necessary to specify the distorted area, third-order nearby elements of the deformed mesh are chosen as the distorted area in this study due to the data structure type of computational models in FDM modelling. Distorted area removal The mesh can be divided into two parts: one is the distorted area that must be eliminated, and the other is the remaining mesh that must be retained. In Section, we utilise the approach of obtaining the surface triangular mesh based on the deformed area.

In conclusion, various issues remain to be addressed when using numerical approaches such as DEM or FDM to analyse mining-induced surface subsidence. DEM modelling is computationally expensive and often impossible for sophisticated and big geological models. Adaptive remeshing is a standard technique for dealing with mesh distortion in FDM modelling, however it primarily focuses on remeshing deformed meshes with only one attribute, ignoring distorted meshes with many attributes.

To address the issues raised above, this work proposes a geometrically and locally adaptive remeshing method for FDM modelling of heavily distorted surface subsidence caused by subterranean mining. The following are the key concepts that underpin the proposed method: I Instead of computation mistakes, geometrical properties of elements (i.e. mesh quality) are used to determine whether to remeshing; and (ii) Distorted meshes with several attributes, rather than those with only a single attribute, are locally regenerated..

Acknowledgement

I would like to thank my Professor for his support and encouragement.

Conflict of Interest

The authors declare that they are no conflict of interest.

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***Corresponding author:** Nengxiong Xu, School of Engineering and Technology, China University of Geosciences (Beijing), Beijing, 100083, China, E-mail: xungxiong@cugb.edu.cn

Received: 04-Apr-2022, Manuscript No: jpmm-22-63176, **Editor assigned:** 06-Apr-2022, Pre QC No: jpmm-22-63176 (PQ), **Reviewed:** 20-Apr-2022, QC No: jpmm-22-63176, **Revised:** 22-Apr-2022, Manuscript No: jpmm-22-63176 (R), **Published:** 28-Apr-2022, DOI: 10.4172/2168-9806.1000209

Citation: Xu N (2022) An Approach for Finite Difference Modeling of Mining that is Geometrically and Spatially Adaptable. J Powder Metall Min 6: 209.