TITLE OF THE INVENTION

2.75D MESHING ALGORITHM

BACKGROUND OF THE INVENTION

1. **Field of the Invention**

[0001] The present invention generally relates to a system and method for generating a grid that can be used to construct a simulation model of a subsurface reservoir, and more particularly, to a system and method configured for modeling geological fractures.

2. **Discussion of the Related Art**

[0002] In the oil and gas industry, reservoir modeling involves the construction of a computer model of a petroleum reservoir for the purposes of improving estimation of reserves and making decisions regarding the development of the field. For example, geological models may be created to provide a static description of the reservoir prior to production. In contrast, reservoir simulation models may be created to simulate the flow of fluids within the reservoir over its production lifetime.

[0003] One challenge with reservoir simulation models is the modeling of fractures within a reservoir, which requires a thorough understanding of matrix flow characteristics, fracture network connectivity and fracture-matrix interaction. Fractures can be described as open cracks or voids within the formation and can either be naturally occurring or artificially generated from a wellbore. The correct modeling of the fractures is important as the properties of fractures such as spatial distribution, aperture, length, height, conductivity, and connectivity significantly affect the flow of reservoir fluids to the well bore.

[0004] Accordingly, the disclosed embodiments provide a system, method, and computer program product for generating hybrid computational meshes around complex and discrete fractures for the purpose of reservoir simulation.

SUMMARY

[0004a] According to a first aspect of the present invention, there is provided a computer-implemented method for modeling three-dimensional (3D) geological fractures, the method comprising: receiving a 3D domain that includes discretized two-dimensional (2D) fracture surfaces representative of the 3D geological fractures; intersecting the 3D domain with a set of non-intersecting 2D slicing surfaces to generate a set of 2D fracture line segments on each 2D slicing surface at the intersection of a respective 2D slicing surface

and the 2D fracture surfaces; for each 2D slicing surface: for each straight line segment in each fracture line segment of the set of fracture line segments: generating a set of stadia at a specified radii from a straight line segment, generating closed loops around all the straight line segments of the fracture line segment, and generating various shape cells within the closed loops of the straight line segment; generating a constrained cell mesh around the closed loops of the set of fracture line segments to fill in a remainder space of the 2D slicing surface to produce a discretized slice surface; and assigning reservoir properties and a volume attribute to each 2D cell within the discretized slice surface; and establishing communication between 2D cells of a fracture on adjacent 2D discretized slice surfaces.

[0004b] According to a second aspect of the present invention, there is provided a non-transitory computer readable medium comprising computer executable instructions for modeling a three-dimensional (3D) structure, the computer executable instructions when executed causes one or more machines to perform operations comprising: receiving a 3D domain that includes discretized two-dimensional (2D) fracture surfaces representative of the 3D geological fractures; intersecting the 3D domain with a set of non-intersecting 2D slicing surfaces to generate a set of 2D fracture line segments on each 2D slicing surface at the intersection of a respective 2D slicing surface and the 2D fracture surfaces; for each 2D slicing surface: for each straight line segment in each fracture line segment of the set of fracture line segments: generating a set of stadia at a specified radii from a straight line segment, generating closed loops around all the straight line segments of the fracture line segment, and generating various shape cells within the closed loops of the straight line segment; generating a constrained cell mesh around the closed loops of the set of fracture line segments to fill in a remainder space of the 2D slicing surface to produce a discretized slice surface; and assigning reservoir properties and a volume attribute to each cell within the discretized slice surface; and establishing communication between cells of a fracture on adjacent 2D discretized slice surfaces.

[0004c] According to a third aspect of the present invention, there is provided a system, comprising: at least one processor; and at least one memory coupled to the at least one processor and storing computer executable instructions that when executed by the at least one processor performs operations comprising: receiving a 3D domain that includes discretized two-dimensional (2D) fracture surfaces representative of the 3D geological fractures; intersecting the 3D domain with a set of non-intersecting 2D slicing surfaces to generate a set of 2D fracture line segments on each 2D slicing surface at the intersection of a respective 2D slicing surface and the 2D fracture

surfaces; for each 2D slicing surface: for each straight line segment in each fracture line segment of the set of fracture line segments: generating a set of stadia at a specified radii from a straight line segment, generating closed loops around all the straight line segments of the fracture line segment, and generating various shape cells within the closed loops of the straight line segment; generating a constrained cell mesh around the closed loops of the set of fracture line segments to fill in a remainder space of the 2D slicing surface to produce a discretized slice surface; and assigning reservoir properties and a volume attribute to each cell within the discretized slice surface; and establishing communication between cells of a fracture on adjacent 2D discretized slice surfaces.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] Illustrative embodiments of the present invention are described in detail below with reference to the attached drawing figures, which are incorporated by reference herein and wherein:

[0006] Figure 1 illustrates an image of three-dimensional fractures that are modeled in accordance with the disclosed embodiments;