adding the volume of each truncated prism together, which represents an Original Oil in Place;

dividing the Original Oil in Place by a Formation Volume Factor, which represents a Stock Tank Original Oil in Place; and

multiplying the Stock Tank Original Oil in Place and a recovery factor, which represents Recoverable Hydrocarbon Reserves.

11. The program carrier device of claim ~~9~~, wherein the attribute value represents a value for an attribute from one of porosity, permeability, fluid saturation and net to gross ratio.

12. The program carrier device of claim ~~9~~, wherein the resampled attribute grid includes one or more attribute grid nodes with an attribute value that is null.

13. The program carrier device of claim ~~11~~, wherein the value of each unified grid node that is the product of the thickness value and a null attribute value is invalid.

14. The program carrier device of claim ~~9~~, wherein the average value is determined by dividing a sum of the attribute values for the resampled attribute grid nodes by a total number of resampled attribute grid nodes.

15. The program carrier device of claim ~~9~~, wherein the attribute grid is resampled using bicubic interpolation.

16. The program carrier device of claim ~~9~~, wherein the constant value is zero.

17. The program carrier device of claim ~~9~~, further comprising improving production from the reservoir using the Recovered Hydrocarbon Reserves.

18. The program carrier device of claim ~~9~~, wherein each truncated prism is created by connecting each vertex for a respective triangle to a plane including only an x-value and a y-value of the respective vertex at z=0.

19. A non-transitory program carrier device tangibly carrying computer-executable instructions for determining reserve estimates for a reservoir, the instructions being executable to implement:

resampling an attribute grid by matching the attribute grid and a thickness grid so that the attribute grid includes an attribute grid node at each location of a thickness grid node;

creating a unified grid with a plurality of cells and a unified grid node at each location of an attribute grid node; wherein each unified grid node includes a value that is the product of a thickness value of a thickness grid node at a location of the respective unified grid node and an attribute value of a respective resampled attribute grid node at the location of the respective unified grid node;

replacing each invalid value for a respective unified grid node;

dividing each cell of the unified grid into four triangles, wherein each of the four triangles includes a vertex at a center of the respective cell and two vertices that form one of four sides of the respective cell;

DETERMINING RESERVE ESTIMATES FOR A RESERVOIR

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The priority of U.S. Provisional Patent Application No. 61/866,901, filed August 16, 2013, is hereby claimed and the specification thereof is incorporated herein by reference. This application and U.S. Patent Application Serial Nos. 14/431,758, 14/431,763 and 14/431,766, which are incorporated herein by reference, are commonly assigned to Landmark Graphics Corporation.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH

[0002] Not applicable.

FIELD OF THE DISCLOSURE

[0003] The present disclosure generally relates to systems and methods for determining reserve estimates for a reservoir. More particularly, the present disclosure relates to determining reserve estimates for a reservoir using a thickness grid multiplied by one or more grids of laterally-varying attributes to produce a unified grid from which the reserve estimates are determined.

BACKGROUND

[0004] Accurate reserve estimates are critical in the industry for proper risk assessment and providing these in a structural framework setting is unique. Traditional volumetric calculations are purely grid-based and define the volume between surfaces/horizons by computing and summarizing horizontal slices. The slicing technique does not accurately define geologic volumes especially with complex geometries such as fault blocks or salt bodies. In addition, it is challenging for the user to gain an accurate three-dimensional visual representation of the calculated volumes. Geocellular-based volume calculations also inadequately define volumes due to stair-stepped geometry representations.

adding the volume of each truncated prism together, which represents an Original Oil in Place;

dividing the Original Oil in Place by a Formation Volume Factor, which represents a Stock Tank Original Oil in Place; and

multiplying the Stock Tank Original Oil in Place and a recovery factor, which represents Recoverable Hydrocarbon Reserves.

11. The program carrier device of claim 10, wherein the attribute value represents a value for an attribute from one of porosity, permeability, fluid saturation and net to gross ratio.

12. The program carrier device of claim 10, wherein the resampled attribute grid includes one or more attribute grid nodes with an attribute value that is null.

13. The program carrier device of claim 12, wherein the value of each unified grid node that is the product of the thickness value and a null attribute value is invalid.

14. The program carrier device of claim 10, wherein the average value is determined by dividing a sum of the attribute values for the resampled attribute grid nodes by a total number of resampled attribute grid nodes.

15. The program carrier device of claim 10, wherein the attribute grid is resampled using bicubic interpolation.

16. The program carrier device of claim 10, wherein the constant value is zero.

17. The program carrier device of claim 10, further comprising improving production from the reservoir using the Recovered Hydrocarbon Reserves.

18. The program carrier device of claim 10, wherein each truncated prism is created by connecting each vertex for a respective triangle to a plane including only an x-value and a y-value of the respective vertex at z=0.

19. A non-transitory program carrier device tangibly carrying computer-executable instructions for determining reserve estimates for a reservoir, the instructions being executable to implement:

resampling an attribute grid by matching the attribute grid and a thickness grid so that the attribute grid includes an attribute grid node at each location of a thickness grid node;

creating a unified grid with a plurality of cells and a unified grid node at each location of an attribute grid node; wherein each unified grid node includes a value that is the product of a thickness value of a thickness grid node at a location of the respective unified grid node and an attribute value of a respective resampled attribute grid node at the location of the respective unified grid node;

replacing each invalid value for a respective unified grid node;

dividing each cell of the unified grid into four triangles, wherein each of the four triangles includes a vertex at a center of the respective cell and two vertices that form one of four sides of the respective cell;