

accurately describe the attributes of existing wells or new wells with the same geography.

SUMMARY

[0004a] In one aspect, a method for predicting a risk during drilling operations of a well, which comprises: a) defining a course layer model and a fine layer model for each layer of the course layer model based on a model type for the well; b) training the coarse layer model and each fine layer model using a computer processor, the model type and at least one of segmented historical data and one or more extracted features representing each respective historical data segment; (c) repeating steps a) - b) with another model type until the course layer model and each fine layer model are acceptable; and d) predicting the predetermined risk for the well using an acceptable course layer model, each acceptable fine layer model and real-time data for the well.

[0004b] In another aspect, a non-transitory program carrier device tangibly carrying computer executable instructions for predicting a risk during drilling operations of a well, the instructions being executable to implement: a) defining a course layer model and a fine layer model for each layer of the course layer model based on a model type for the well; b) training the coarse layer model and each fine layer model using the model type and at least one of segmented historical data and one or more extracted features representing each respective historical data segment; c) repeating steps a) – b) with another model type until the course layer model and each fine layer model are acceptable; and d) predicting the predetermined risk for the well using an acceptable course layer model, each acceptable fine layer model and real-time data for the well.

[0004c] In yet another aspect, a non-transitory program carrier device tangibly carrying computer executable instructions for predicting a risk during drilling operations of a well, the instructions being executable to implement: defining a course layer model and a fine layer

model for each layer of the course layer model based on a model type for the well; training the coarse layer model and each fine layer model using the model type and at least one of segmented historical data and one or more extracted features representing each respective historical data segment; and predicting the predetermined risk for the well using the course layer model, each fine layer model and real-time data for the well.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] The present disclosure is described below with references to the accompanying drawings in which like elements are referenced with like reference numerals, and in which:

[0006] **FIG. 1** is a flow diagram illustrating one embodiment of a method for implementing the present disclosure.

[0007] **FIG. 2** is a display illustrating an exemplary format for multiple attributes of the historical data input in step **104** of **FIG. 1**.

[0008] **FIG. 3** is a display illustrating an exemplary format for the historical data segmented in step **106** of **FIG. 1**.

[0009] **FIG. 4** is a display illustrating exemplary techniques for extracting one or more features representative of each respective historical data segment in step **110** of **FIG. 1**.

[0010] **FIG. 5** is a display illustrating an exemplary coarse layer model and fine layer model defined in step **112** of **FIG. 1**.

[0011] **FIG. 6** is a display illustrating an exemplary graphical user interface for monitoring the risk predicted in step **120** of **FIG. 1** and managing the drilling operations for each uncompleted well.

[0012] **FIG. 7** is a block diagram illustrating one embodiment of a computer system for implementing the present disclosure.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] The present disclosure therefore, overcomes one or more deficiencies in the prior art by providing systems and methods for real-time risk prediction during drilling operations using real-time data from an uncompleted well, a trained coarse layer model and a trained fine