identical log-distance and clock orientation. However, virtually all ILI measurements have some sizing, detection, or location uncertainties that can cause features to be matched incorrectly. When features are matched incorrectly, the accuracy of the estimate of the corrosion rate decreases. Therefore, a method of estimating the corrosion rate is needed that accounts for the uncertainties that are inherent in the feature matching process.

According to a first aspect, there is provided a method of maintaining a pipeline, the method comprising the acts of: estimating a corrosion rate of a segment of the pipeline based on a first data set obtained by inspecting the pipeline segment at a first time and a second data set obtained by inspecting the pipeline segment at a second time subsequent to the first time, wherein the first data set includes a plurality of first features within the pipeline segment at the first time and the second data set includes a plurality of second features within the pipeline segment at the second time, wherein the estimating of the corrosion rate of the pipeline segment comprises the acts of: identifying a plurality of matched features within the pipeline segment, wherein each of the matched features includes one of the first features and one of the second features that correlate with each other; calculating a confidence metric for each of the matched features; selecting a subset of the matched features based on at least one of the confidence metric of each of the matched features, a size of each of the matched features, and a desired size of the subset of the matched features; and calculating the corrosion rate of the pipeline segment based on changes in a geometric characteristic of features within the subset of the matched features between the first time and the second time; and performing maintenance on the pipeline based on the estimated corrosion rate of the pipeline segment.

According to an ~~aspect~~embodiment of the present invention, there is provided a method of estimating a corrosion rate of a pipeline segment by analyzing a first data set obtained by inspecting the pipeline segment at a first time and a second data set obtained by inspecting the pipeline segment at a second time subsequent to the first time. The first data set includes a plurality of first features within the pipeline segment at the first time and the second data set includes a plurality of second features within the pipeline segment at the second time. The method includes the acts of identifying a plurality of matched features within the pipeline segment, wherein each of the matched features includes one of the first features and one of the second features that correlate with each other; calculating a confidence metric for each of the matched features; selecting a subset of the matched features based on the confidence metric of each of the matched features, a size of each of the matched features, and/or a desired size of the subset of the matched features; and calculating the corrosion rate of the pipeline segment based on changes in a geometric characteristic of features within the subset of the matched features between the first time and the second time.

The identification of the matched features may include the acts of adjusting a log-distance and a clock orientation of each of the first features and/or adjusting a log-distance and a clock orientation of each of the second features; after the adjusting of the log-distances and the clock orientations, generating a correlation matrix that includes a goodness-of-fit metric for a match between each of the first features and each of the second

subset of the matched features.

The geometric characteristic of a feature may include a length, a width, and/or a depth of the feature.

According to a second aspect, there is provided a method of estimating a corrosion rate of a pipeline segment based on a first data set obtained by inspecting the pipeline segment at a first time and a second data set obtained by inspecting the pipeline segment at a second time subsequent to the first time, wherein the first data set includes a plurality of first features within the pipeline segment at the first time and the second data set includes a plurality of second features within the pipeline segment at the second time, the method comprising the acts of: identifying a plurality of matched features within the pipeline segment, wherein each of the matched features includes one of the first features and one of the second features that correlate with each other; calculating a confidence metric for each of the matched features; selecting a subset of the matched features based on at least one of the confidence metric of each of the matched features, a size of each of the matched features, and a desired size of the subset of the matched features; and calculating the corrosion rate of the pipeline segment based on changes in a geometric characteristic of features within the subset of the matched features between the first time and the second time.

According to another ~~aspect~~embodiment of the present invention, there is provided a method of estimating a corrosion rate of a pipeline segment by analyzing a first data set obtained by inspecting the pipeline segment at a first time and a second data set obtained by inspecting the pipeline segment at a second time subsequent to the first time. The first data set includes a plurality of first features within the pipeline segment at the first time and the second data set includes a plurality of second features within the pipeline segment at the second time. The method includes the acts of dividing the first data set into a plurality of first spools that are separated by first girth welds; dividing the second data set into a plurality of second spools that are separated by second girth welds; identifying a plurality of matched spools within the pipeline segment, wherein each of the matched spools includes one of the first spools and one of the second spools that correlate with each other; identifying a plurality of matched features within one of the matched spools, wherein each of the matched features includes one of the first features and one of the second features that correlate with each other; calculating a confidence metric for each of the matched features; selecting a subset of the matched features based on the confidence metric of each of the matched features, a size of each of the matched features, and/or a desired size of the subset of the matched features; and calculating the corrosion rate of the matched spool based on changes in a geometric characteristic of features within the subset of the matched features between the first time and the second time.

The identification of the matched features may include the acts of adjusting a log-distance and a clock orientation of each of the first features and/or adjusting a log-distance and a clock orientation of each of the second features; after the adjusting of the log-

of the matched spool based on statistics of the corrosion rates of each feature within the subset of the matched features.

The geometric characteristic of a feature may include a length, a width, and/or a depth of the feature.

The assessment of the condition of the pipeline, including the estimation of the corrosion rate, can be used as a basis for determining if and when additional efforts are taken to assess or ensure the future operation of the pipeline. For example, the corrosion rate can be used to determine what type of maintenance should be performed on the pipeline, where on the pipeline the maintenance should be performed, when the maintenance should be conducted, the allowable operating conditions of the pipeline, and the like.

According to a third aspect, there is provided a method of estimating a corrosion rate of a pipeline segment based on a first data set obtained by inspecting the pipeline segment at a first time and a second data set obtained by inspecting the pipeline segment at a second time subsequent to the first time, wherein the first data set includes a plurality of first features within the pipeline segment at the first time and the second data set includes a plurality of second features within the pipeline segment at the second time, the method comprising the acts of: dividing the first data set into a plurality of first spools that are separated by first girth welds; dividing the second data set into a plurality of second spools that are separated by second girth welds; identifying a plurality of matched spools within the pipeline segment, wherein each of the matched spools includes one of the first spools and one of the second spools that correlate with each other; identifying a plurality of matched features within one of the matched spools, wherein each of the matched features includes one of the first features and one of the second features that correlate with each other; calculating a confidence metric for each of the matched features; selecting a subset of

the matched features based on at least one of the confidence metric of each of the matched features, a size of each of the matched features, and a desired size of the subset of the matched features; and calculating the corrosion rate of the matched spool based on changes in a geometric characteristic of features within the subset of the matched features between the first time and the second time.

Other ~~objects~~embodiments, advantages, and novel features of the present invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a schematic overview of the feature matching method according to exemplary embodiments of the present invention;

FIG. 2 shows a flowchart of a method of estimating a corrosion rate of a pipeline segment according to exemplary embodiments of the present invention;

FIG. 3A shows a grid that represents a correlation matrix for two successive ILI runs; and

FIG. 3B shows the separation of the correlation matrix into subsets after identifying a matched feature.