accuracy of the GPS used. Between adjacent magloggers the drift effect of the IMU introduces errors, which are a maximum at the mid-lineage point. The size of these errors essentially depends on the lineage between the maglogger locations. As the distance is increased the error increases. With magloggers spaced at 7 km the stated accuracy of the IMU, disclosed in U.S. application Ser. No. 08/996,504, is 1.5 meters rms. At any point along the pipeline route the stated accuracy of that point is within 1.5 meters of its true location.

The location coordinates of logger points can typically be said to have the accuracy of the GPS used to survey the logger locations. In the case of differential GPS, this accuracy is approximately 0.2 meter. At other locations, the accuracy of the location data is dependent on the spacing of the GPS loggers used to recalibrate the IMU data. The greatest inaccuracy (or uncertainty) occurs at mid-logger locations. Typically, the uncertainty is sinusoidal in nature with a maximum of approximately 3 meters at mid-logger locations and zero uncertainty at logger locations.

The ground spatial resolution of the satellite imagery is estimated to be approximately 1 m for panchromatic, and 4 m for multi-spectral. Some products may be available which have both data types fused to produce pan-sharpened imagery having a spatial resolution of 1 m, but including multi-spectral band data. The accuracy of such data is dependent on the particular product used, but could be as low as 12 meters. In most circumstances, the accuracy of the satellite data may be improved to approximately 2 meters using pipeline route GPS information. This accuracy allows for automated surveying or surveillance obviating the need for aerial reconnaissance.

In practice, the satellite based pipeline map of an inspected pipeline can only be as accurate as the base data sources used to produce it. The data sources must be integrated so as to retain the inherent accuracy of the location data provided by the IMU, or other GPS data source, while ensuring that features present in both data sources are matched. The accuracy requirements of the pipeline mapping system are pipeline operator dependent. In the some situations, satellite imagery accurate to within 10 meters is adequate.

If VHR satellite imagery scenes for a pipeline are available before deploying the MIV the pipeline route can be 'previewed' visually. This enables areas where the pipeline is not visible in the imagery to be identified; thus assisting the effective deployment of magloggers to minimize errors during the integration of the location data with the satellite imagery.

The foregoing disclosure and description of the invention are illustrative and explanatory thereof, and various changes in the details of the illustrated apparatus and construction and method of operation may be made without departing from the spirit of the invention.

What is claimed is:

1. A method of providing surveillance for a pipeline, comprising the steps of:

tracking a linear section of a pipeline in satellite data using existing pipeline data, the existing pipeline data comprising pipeline location data;

registering the satellite data to the pipeline location data, retaining the accuracy of the pipeline location data;

merging the satellite data with the existing pipeline data to form a current map of the section of the pipeline; and

comparing the current map with a previous map of the pipeline to detect relative changes between them.

2. The method of claim **1**, wherein the satellite data provides ground features comprising roads, railroads, dwellings, vehicles, valve stations, and maglogger locations.

3. The method of claim **1**, further comprising the steps of:

integrating client data as overlays on the current map.

4. The method of claim **3**, wherein the client data comprises pipeline inspection data, pipeline fixture data, pipeline fitting data, soil condition data, land class data, and land elevation data.

5. The method of claim **1**, wherein the pipeline location data is a series of GPS coordinates.

6. The method of claim **1**, wherein the registering step includes the step of:

capturing a ground control point (GCP) in the satellite data, wherein the GCP is utilized to facilitate merging of the satellite data and the pipeline location data.

7. The method of claim **1**, wherein the registering step is performed using a resample method and an integration method.

8. The method of claim **1**, wherein the tracking step further comprises the steps of:

(a) selecting two end points in the satellite image, wherein each of the two end points correspond to a tracking branch of the pipeline;

(b) scanning pixels of the satellite image along a line orthogonal to a straight line between the two end points, wherein the pixels are scanned from both of the end points;

(c) filtering the scanned pixels using a non-linear filter to identify peaks which indicate a route of the pipeline;

(d) selecting the scanned pixels with a peak closest to the straight line between the two end points;

(e) fitting the selected pixels with a least squares fitting line utilizing a robust fitting method;

(f) setting the two end points to the location of the last selected pixel for each of the tracking branches and repeating steps (b) through (f) until the tracking branches approximately intersect; and

(g) fitting the tracking branches with a least squares error line utilizing the robust fitting method.

9. The method of claim **8**, wherein the selection of the two end points in step (a) is performed manually.

10. The method of claim **1**, wherein the satellite data is VHR satellite imagery.

11. The method of claim **1**, wherein the comparison step is automated using standard image analysis techniques.

12. A computer system that provides for surveillance of a pipeline, the computer system comprising:

a processor;

a video display system coupled to the processor;

a mass storage device coupled to the processor; and

pipeline mapping code in a processor readable medium for causing the processor to perform the steps of:

tracking a linear section of a pipeline in satellite data using existing pipeline data, the existing pipeline data comprising pipeline location data;

registering the satellite data to the pipeline location data, retaining the accuracy of the pipeline location data;

merging the satellite data with the existing pipeline data to form a current map of the section of the pipeline; and

comparing the current map with a previous map of the pipeline to detect relative changes between them.

13. The computer system of claim **12**, wherein the satellite data provides ground features comprising roads, railroads, dwellings, vehicles, valve stations, and maglogger locations.

14. The computer system of claim **12**, the pipeline mapping code further comprising code for causing the processor to perform the step of:

integrating client data as overlays on the current map.