सत्यमेव जयते

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Project Report [Draft]

Automatic DEM Generation Process with Automated Data Download

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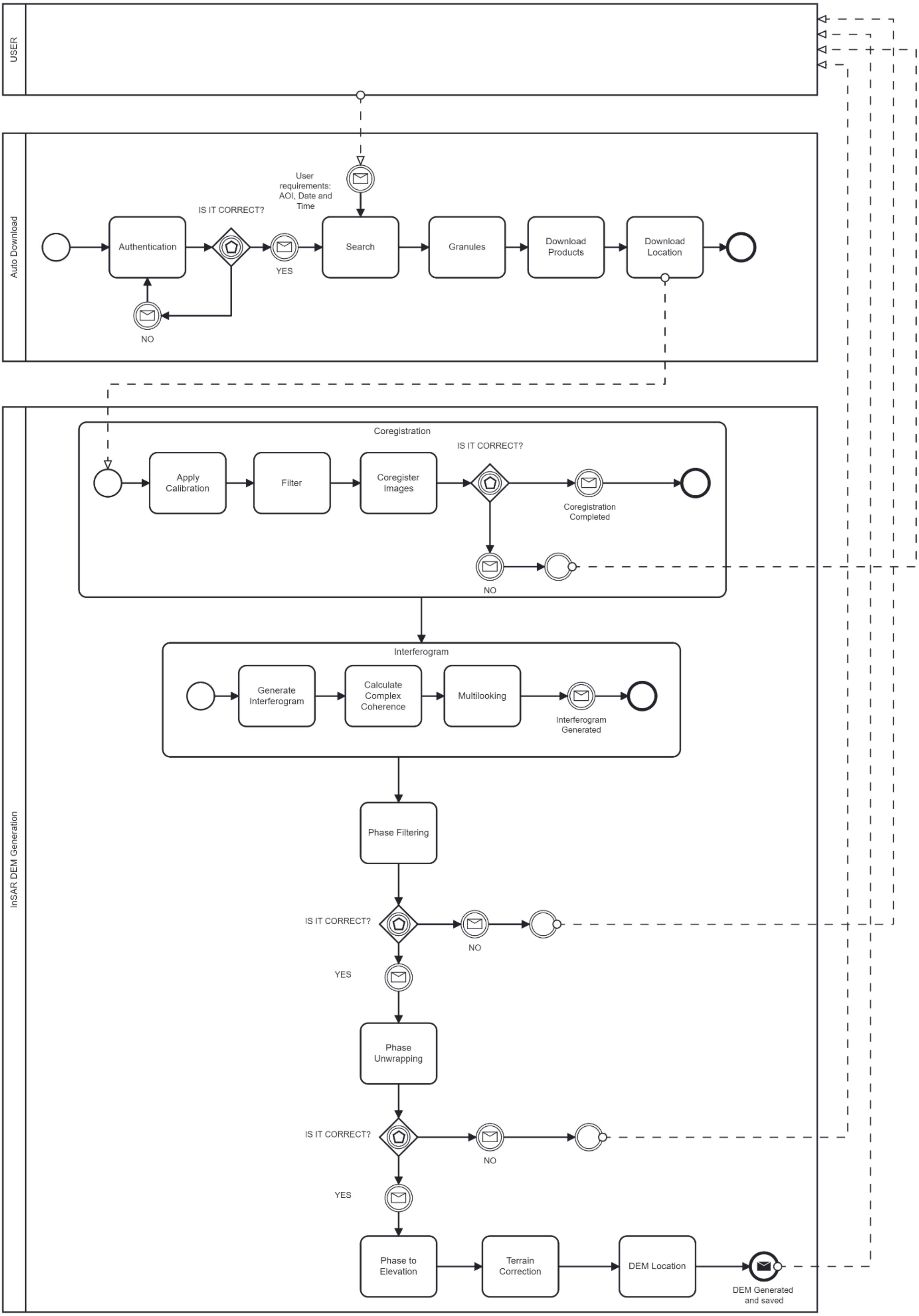
1. Introduction

This report outlines the method and steps involved in generating a Digital Elevation Model (DEM) through an automated process using interferogram data acquired from Synthetic Aperture Radar (SAR). The DEM provides valuable information for various applications, including terrain mapping, subsidence monitoring, and surface deformation analysis. This report presents a detailed description of the process flow, including three distinct pools: Data Acquisition, Interferogram Generation, and DEM Processing. The automated process streamlines the generation of DEMs by leveraging interferogram data derived from SAR acquisitions. The interferogram serves as a powerful tool for extracting elevation information and creating high-resolution topographic maps. By automating the process, efficiency and accuracy are enhanced, enabling rapid and reliable DEM generation. The report will outline the steps involved in each pool, including automated data acquisition, interferogram generation, and subsequent processing to generate the final DEM. Through this comprehensive analysis, readers will gain insights into the automated generation of DEMs using interferogram, empowering them to leverage SAR data for precise terrain analysis and monitoring applications.

2. Business Process Modelling & Notation [BPMN] Diagram



3. Data Acquisition Pool

The Data Acquisition pool focuses on the automated downloading of SAR data. This pool includes the following steps:

3.1. Authentication

- Establish a secure connection with the data source.
- Obtain the necessary access credentials or API keys required for authentication to ensure authorized access to the data.

3.2. Search

- Define the search criteria based on specific user requirements, such as acquisition dates, geographic region, sensor type, and other relevant parameters.

3.3. Granules

- Analyse the search results and select the desired data granules or scenes for download.

3.4. Download Products

- Initiate the automated download process for the selected SAR data products.

3.5. Download Location

- Specify the appropriate storage location for the downloaded data products.

4. Interferogram Generation Pool

This pool includes the following Processes:

4.1. Coregistration

This Process includes following tasks

4.1.1. Applying Calibration

- o Perform radiometric calibration to convert the SAR data from digital numbers to calibrated radar backscatter values.

4.1.2. Filtering

- o Apply speckle filtering techniques, such as Lee, Frost, or Gamma-MAP filters, to reduce the noise and improve the quality of the SAR images.

4.1.3. Co-register Images

- o Identify tie points or matching features between the calibrated and filtered SAR images.
- o Apply geometric transformations, such as translation, rotation, and scaling, to align the images accurately.

4.2. Interferogram generation

This Process includes following tasks.

4.2.1. Generate Interferogram

- o Multiply the complex values of two coregistered SAR images to obtain the interferometric phase.
- o Generate the interferogram, which represents the phase difference between the two acquisitions.

4.2.2. Calculating Complex Coherence

- o Measure the complex coherence, which quantifies the similarity between the two coregistered images.
- o Calculate the coherence by analysing the magnitude and phase of the complex values of the two images.

4.2.3. Multilooking

- o Perform multilooking, which involves averaging the interferogram pixels to reduce spatial resolution.

4.3. Phase Filtering

- Apply appropriate filtering techniques, such as adaptive filtering or Goldstein filtering, to enhance the quality of the interferogram.
- Remove noise and unwanted signals while preserving the underlying phase information.

4.4. Phase Unwrapping

- Unwrap the interferometric phase to remove phase ambiguities caused by the limited range of phase values.
- Convert the wrapped phase into continuous, unwrapped phase information.

4.5. Phase to Elevation

- Convert the interferometric phase to elevation values by relating the phase differences to the topographic heights.

4.6. Terrain Correction

- Apply terrain corrections to account for topographic variations and distortions in the interferometric phase.
- Correct for the effects of the Earth's curvature, radar incidence angles, and atmospheric artefacts.

4.7. DEM Location

- Specify the appropriate storage location for the generated DEM.

4.8. DEM Generation and Saving

- Generate the final DEM using the processed interferogram and terrain-corrected elevation values.
- Save the generated DEM in a suitable format for further analysis and visualization.
- Ensure proper metadata documentation and file management for future reference.

5. Conclusion

The generation of a Digital Elevation Model (DEM) through an automated workflow using interferogram data involves two main stages: Data Acquisition, Interferogram Processing. In the Data Acquisition stage, automated processes facilitate the retrieval of Synthetic Aperture Radar (SAR) data by performing authentication, searching for relevant data granules, and determining the download location.

The Interferogram Generation stage encompasses tasks such as calibration, filtering, coregistration, interferogram formation, complex coherence calculation, and multilooking. These tasks ensure the alignment of SAR images, the creation of the interferogram, and the enhancement of data quality. Once the interferogram is generated, the subsequent tasks in the Interferogram Generation stage include phase filtering, phase unwrapping, phase to elevation conversion, terrain correction, DEM location, and the actual generation and saving of the DEM. These tasks refine the interferogram, resolve phase ambiguities, convert phase differences to elevation values, correct for terrain-related errors, and produce the final DEM in a suitable format.

Overall, this automated workflow optimizes the process of DEM generation from interferogram data, improving efficiency and accuracy.