Generation of Accurate and Complete As-is BIMs based on Progressive Laser Scanned Data

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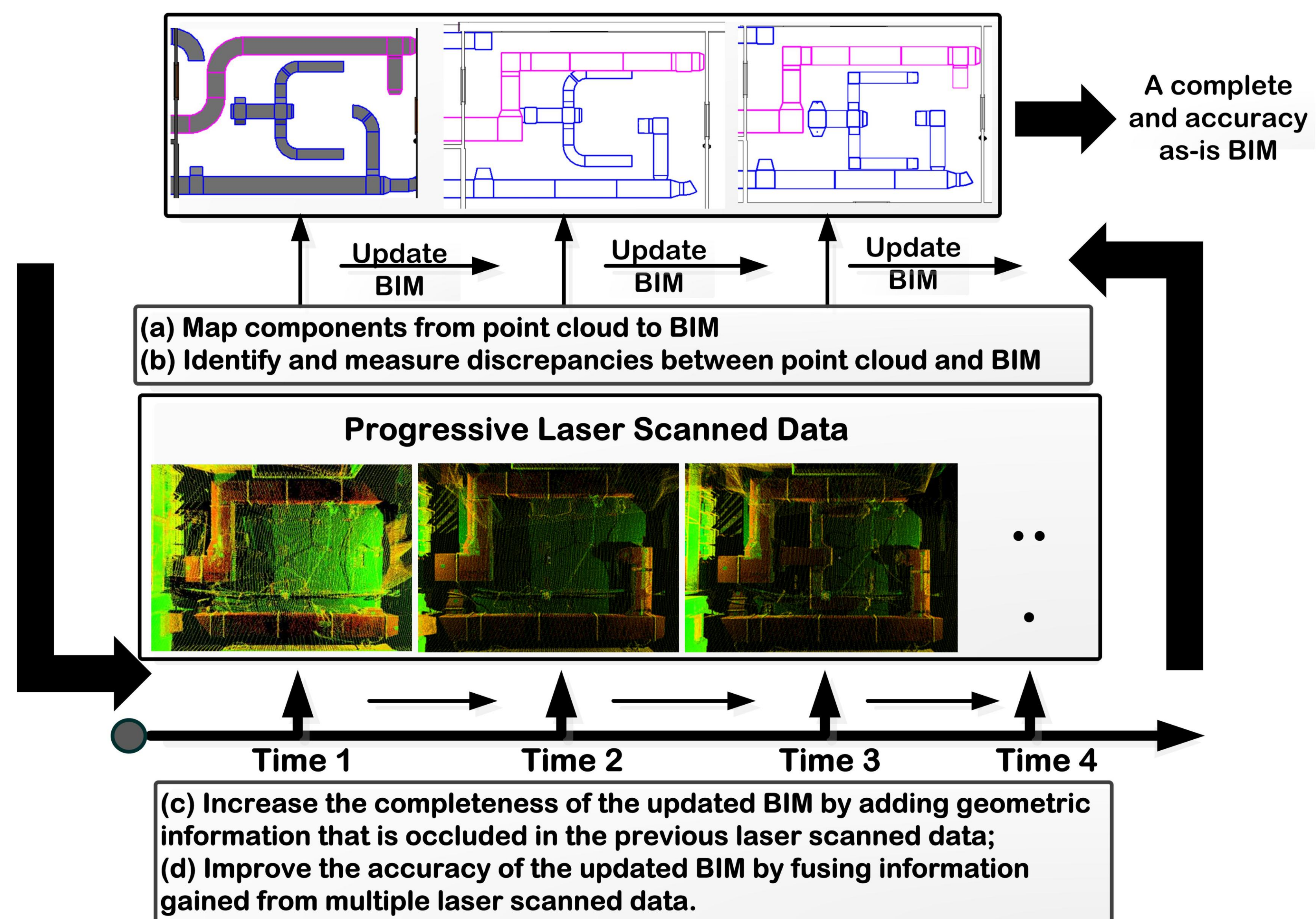
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Motivation & Problem Statement

➢ **The need for** having accurate and complete as-is BIMs:
- To support various engineering applications (e.g., O&M activities, retrofit and renovation planning).
- $4.8 billion to verify that as-built documentation represents existing conditions (NIST 2004).
- Laser scanned technology provides opportunities to capture accurate as-is condition of facilities in a short amount of time.

➢ **Problem**:
- Laser scanned data captured at a single point in time will only provide a partial view of a facility.
- Sematic information need to be added to the laser scanned data (i.e., a collection of 3D points).

Vision and Objective

➢ **Objective**: Develop a framework to update as-designed BIM continuously throughout the construction/renovation phase by incorporating as-is geometric information captured by the progressive laser scanned data.

➢ **The primary functions** include:
- Correctly mapping components from point cloud to BIM.
- Identifying discrepancies between point cloud and BIM.
- Leveraging progressive laser scanned data to improve accuracy and completeness of BIM.

A complete and accuracy as-is BIM

Update BIM

(a) Map components from point cloud to BIM
(b) Identify and measure discrepancies between point cloud and BIM

Progressive Laser Scanned Data

Time 1   Time 2   Time 3   Time 4

(c) Increase the completeness of the updated BIM by adding geometric information that is occluded in the previous laser scanned data;
(d) Improve the accuracy of the updated BIM by fusing information gained from multiple laser scanned data.

Research Approach and Initial Findings

➢ Discrepancies identified in the motiving case

a. Shape discrepancy

b. Location discrepancy

0.7m   0.87m
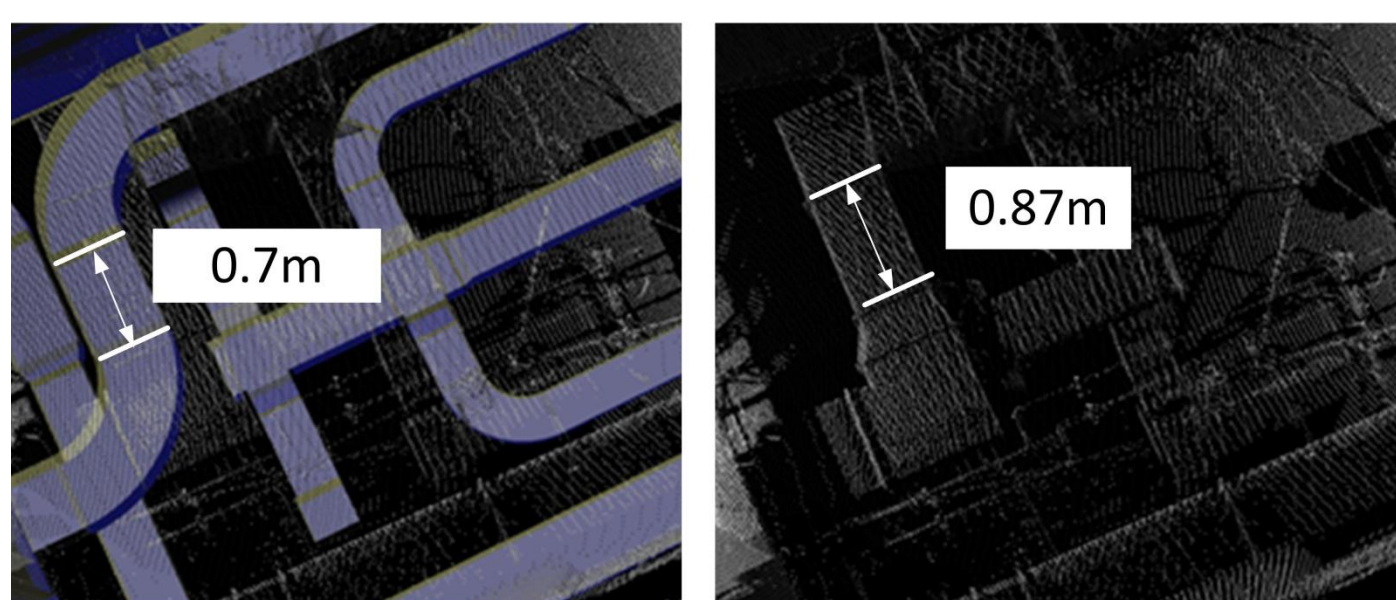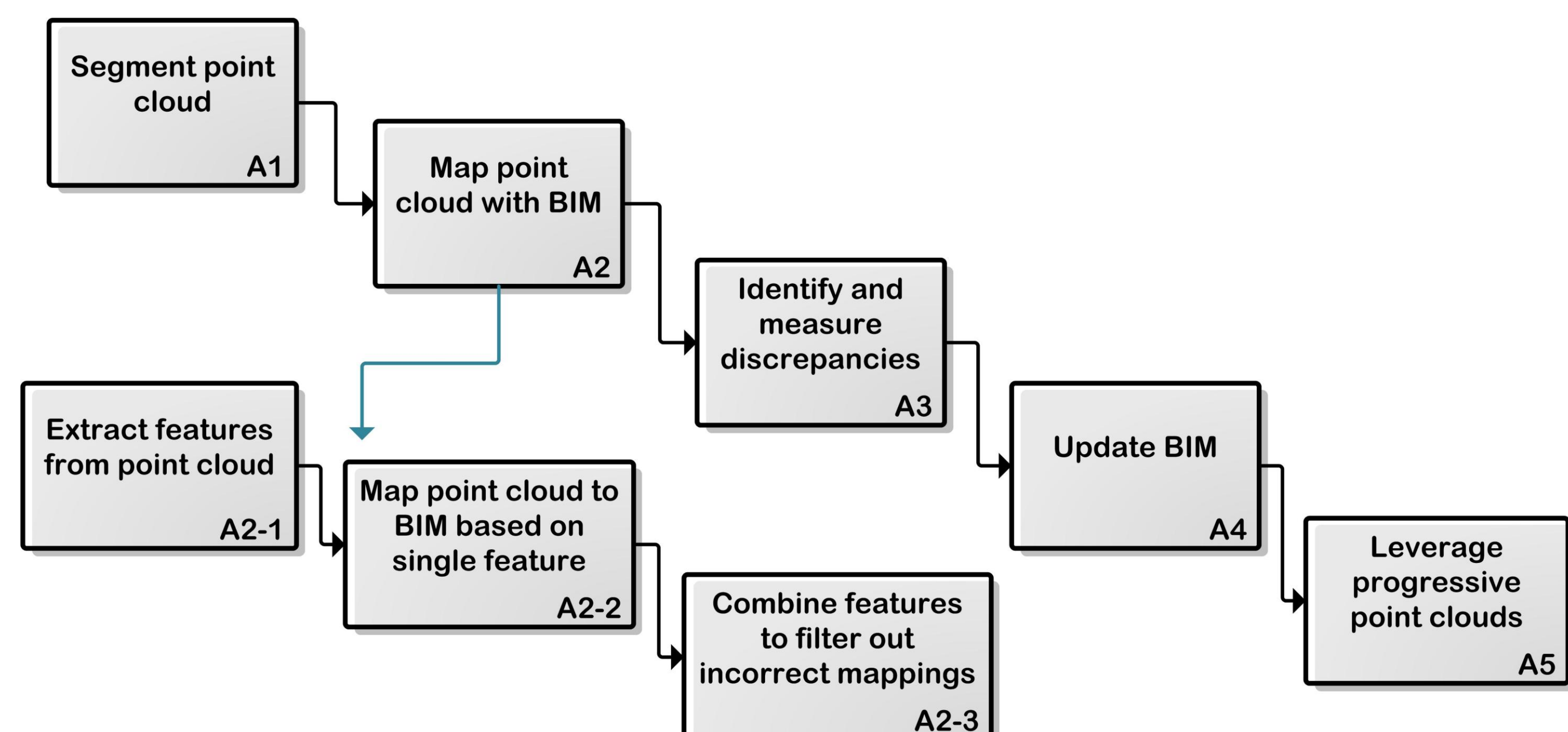
c. Dimension discrepancy
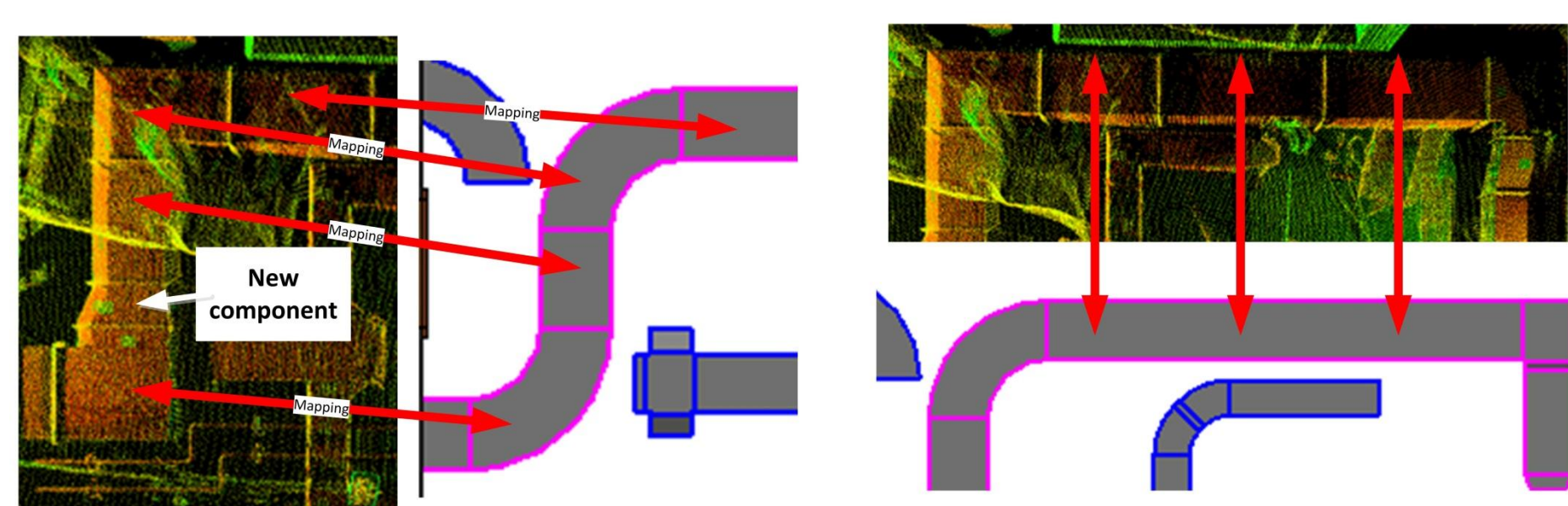
New component

d. Component discrepancy

e. Composition discrepancy

➢ Research approach:

Segment point cloud — A1

Map point cloud with BIM — A2

Extract features from point cloud — A2-1

Map point cloud to BIM based on single feature — A2-2

Combine features to filter out incorrect mappings — A2-3

Identify and measure discrepancies — A3

Update BIM — A4

Leverage progressive point clouds — A5

➢ Expected contribution:
- A mapping mechanism to map point cloud to BIM when discrepancies are existed.
- A framework to increase the reliability of as-is BIM by fusing progressive laser scanned data.