Improving Representations of As-Is BIMs Obtained from Laser Scanned Point Clouds

Engin Burak Anil[1], Burcu Akinci[2]

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Accurate as-is BIMs that are representative of the facilities existing conditions can help decision makers to base their decisions on actual and up-to-date information rather than largely assumed or missing data. Laser scanning enables fast and accurate data collection with greater coverage of the environment compared to other methods of measurement, such as tape measures. Collection of data using laser scanners is therefore becoming a common practice for collecting data for generating as-is BIMs. However, current practice of as-is BIM generation from point cloud and as-is condition representation approaches were not initially developed for modeling as-is conditions at such high accuracy and coverage. Additionally, scanner data contains noise and occlusions. Despite the great benefits of as-is BIMs and utilization of laser scanning technology for this purpose, the emerging paradigm of generating as-is BIMs from laser scanner data sometimes brings a false sense of trust. In order for as-is BIM users to make informed decisions, these characteristics should be incorporated into the BIM generation procedure and provided to the decision makers. The goal of our research is to understand the implications of current as-is BIM generation from decision makers' perspective and improve the as-is BIM generation and representation practice, so that the implications of these problems can be minimized and decisions can be made with greater accuracy and confidence.

In the current practice of modeling from the laser scanner data several assumptions are made. For example, the laser scanner data is generally assumed to be complete, meaning that coverage of the environment is 100%, free of measurement errors and noise. However, occlusions are almost always inevitable. In one study performed by our group on office environments, it was found that 50% of the analyzed surfaces were occluded. Hence, for example, when measuring a dimension on a model generated from such an incomplete data, there is 50% chance that the measurement cannot be backed by actual data. What can be worse than an inaccurate measurement is that the occluded regions can contain equipment, pipes, or other fixed objects. In such a case, how would one order prefabricated material with confidence solely based on the model? Similarly, inaccuracy of the data has direct effects on the model that is generated from the point cloud. Although, inaccuracy of the scan data can be quantified, once it is turned into BIM, that information is lost and any decision taken based on the as-is BIM is actually taken without knowledge of the accuracy of the scan.

Current as-is modeling practice builds largely on the existing as-designed modeling practice. One direct effect of using design approaches for modeling real life objects is that building elements are generally modeled as ideal. For example, while a wall can be perfectly planar and vertical in the design world, it almost impossible to construct such a perfect surface. Similarly, walls and floors are assumed to be perpendicular. Although these assumptions seem appropriate in some cases, they can only be valid if the requirements (accuracy and modeling) of the project allows.

In order to make informed and accurate decisions from as-is models, a decision maker may need to understand how the model was generated, what were the modeling assumptions, how was the data treated, accuracy and noise levels of the data, and how different is the model from the real object. These aspects of the model generation can be represented along with the BIM objects and provided to the decision makers so that they can make more informed decisions. In this research, we are seeking methods of quantifying and representing these properties of as-is models. Our research approach consists of 1) understanding what kinds of decisions are made based on as-is models, 2) bottlenecks of the current practice for supporting these decisions, and 3) how the modeling approaches and representation methods can be improved so that the practice can be improved towards more informed and accurate decisions.

Contact info:
[1]eanil@andrew.cmu.edu, (412) 378-1093
[2]bakinci@cmu.edu, (412) 268-2959