Aalto University
School of Engineering

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# Towards more photorealistic urban 3D models

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| **Title of the dissertation** | Improving the utilization of close-range photogrammetry and terrestrial laser scanning for photorealistic urban 3D modeling. |
| **Contents of the dissertation** | Photorealistic urban 3D models have become valuable and much-requested tools for visualizing, managing, developing, and understanding growing and densifying urban environments in diverse use cases ranging from digital twins to virtual experiences. Close-range photogrammetry and terrestrial laser scanning (TLS) can produce accurate, detailed, and photorealistic 3D models from complex urban environments. These close-range 3D measuring techniques are well acknowledged for their complementary benefits and accuracy. However, the quality of the model appearance has been rarely assessed for photorealism. Furthermore, the 3D model itself does not guarantee its usefulness, though the application platform plays a significant role in putting it into beneficial use.<br><br>The dissertation developed ways to improve the utilization of close-range photogrammetry and TLS for photorealistic urban 3D modeling. The results identified real-time 3D platforms (i.e., game engines and virtual globes) as the most relevant application platforms for utilizing photorealistic urban 3D models. Integrating close-range photogrammetry and TLS proved a good compromise for efficient model production between the superior texture quality of photogrammetry and better geometric quality of TLS. Finally, a new method was developed for evaluating the quality of TLS point cloud colorization, which revealed quality differences among all tested commercial TLS instruments and settings.<br><br>The research improved the utilization of and offered a deeper understanding of the efficiency and quality of close-range photogrammetry and TLS for photorealistic urban 3D modeling. For photorealistic use cases, it is crucial to understand the quality of a 3D model as a combination of geometry and appearance. Together, the close-range 3D measuring methods and real-time 3D platforms enable the efficient and beneficial creation and utilization of highly detailed, photorealistic, urban 3D models in both new and well-established fields. |
| **Field of the dissertation** | Geoinformatics |
| **Doctoral candidate** | Arttu Julin, M.Sc. (Tech.), born in 1987 in Kouvola, Finland |
| **Time of the defence** | 19 November 2021 at 12:00 hours |
| **Place of the defence** | Aalto University School of Engineering, Department of Built Environment, Otakaari 4, 02150 Espoo, Finland, Lecture Hall 216. |
| **Opponent** | Professor Fabio Remondino, FBK Trento, Italy |
| **Supervisor** | Professor Matti T. Vaaja, School of Engineering, Aalto University, Finland |
| **Electronic dissertation** | https://aaltodoc.aalto.fi/handle/123456789/110787 |
| **Doctoral candidate's contact information** | Arttu Julin, Aalto University, arttu.julin@aalto.fi, phone +358 40 5679961. |