A series of critical transmission lattice towers failures due to severe ice and wind loads forced German utility companies to reassess the structural stability of their power grid infrastructure. During the structural reassessment process, a problem related to an outdated or even missing documentation of the in-use infrastructure occurred. This issue forced utility companies to gather the data regarding the geometry of the lattice towers on-site, using specialized and labor-intensive geodetic measuring methods. The scale of the required data acquisition endeavor and stability checks to be performed encouraged the use of alternative methods to capture the geometry of the in-situ structures and reconstruct geometric models to be applied during the structural stability checks in a reliable and efficient way.

This work presents an innovative method to generate a geometric CAD model using point cloud data captured by a LiDAR scanner. The CAD model can be later implemented for FEA utilized during structural stability assessments. The modeling process defined in this study is fully automatized, enabling to obtain repeatable results and save the time required for manual data processing. For the input point cloud data, two types: Aerial and Terrestrial LiDAR point clouds have been investigated allowing to identify the applicability of both data sets for the proposed method.

The model generated with the automatic method proposed in this study is compared in terms of geometric discrepancies to an idealized model based on design documentation and a LiDAR point cloud based model manually generated with a commercial software. The two models used for comparison depict a traditional structural engineering approach and a state-of-the-art method within the point cloud processing field accordingly. At the final stage of this work, the automatically generated point cloud based model is used for a non-linear FEA and compared to a FEA response of the idealized mod-el.

Results showcase that LiDAR point cloud data is a good source of geometric information to reconstruct a geometric CAD model which can later be implemented in FEA. Obtained results are comparable to the ones of an idealized model based on design documentation in terms of collapse mechanism and ultimate load applied at the failure step. Additionally, the geometrical comparison between the point cloud based models generated with the manual method and the one proposed in this work underline the ad-vantage of the automatic method in terms of permissible level of detail and overall precision of the final geometric model. What is more, the impact of point cloud data usage for FEA modeling is shown. Investigating differences between FEA results of the point cloud based and idealized models allow to showcase the influence of real life imperfections on force redistribution across the analyzed structure and ultimate forces reached by members loaded in compression.

The modeling method and analysis results presented in this work can be applied as a set of guidelines for future applications related to point cloud data processing of steel lattice structures used for FEA modeling purposes.