

# 3D morphological reconstruction from magnetic data using deep learning

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**Abstract.** Accurate 3D reconstruction is essential for the design of cus-tomized orthotics. Traditional methods rely on expensive optical scan-ners or complex manual measurements. This work proposes an alterna-tive approach based on the use of magnetic sensors for 3D shape recon-struction. By placing magnetic sensors around the surface of the object, it becomes possible to acquire spatial information without the constraint of direct visibility. An artificial intelligence model is developed to predict and reconstruct the missing 3D point cloud, which can then be used for modeling and 3D printing orthotics. This method aims to make the man-ufacture of custom orthotics more accessible, portable, and economical.

**Keywords:** 3D reconstruction      Magnetic sensors      Deep learning  
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## 1 Introduction

The design of customized orthoses relies on the ability to accurately reconstruct the three-dimensional geometry of the patient’s limb. Traditional 3D scanning methods rely primarily on optical scanners or photogrammetry techniques, offer-ing high accuracy but requiring expensive equipment, technical expertise, and controlled lighting conditions [1]. These constraints limit their use in routine clinical settings or in resource-limited environments.

Magnetic sensors are a promising alternative to optical sensors for capturing spatial data. They enable the acquisition of positional information even in the absence of direct visibility, making it possible to take measurements in areas that are hidden or difficult to access [2]. However, the data obtained is often partial or noisy, which complicates direct 3D reconstruction.

In this context, artificial intelligence can be used to complete and reconstruct partially measured point clouds. Recent deep learning approaches applied to 3D completion exploit neural network architectures capable of modeling the spatial

structure of an object from an incomplete set of points [3]. The objective of this work is to develop an AI model capable of predicting and reconstructing the missing points in a partial cloud derived from magnetic measurements, in order to generate models that can be used for the manufacture of customized orthoses by 3D printing.

## 2 Methodology and results

A deep learning model is trained using supervised learning, with input from magnetic sensors and output from optical scan references. Evaluation is performed on new shapes in order to measure the model's generalization ability. The system achieves an average error of 4.9 mm between reconstruction and reference on previously unseen shapes. However, the model does not generalize perfectly and still exhibits inconsistencies in some cases. Areas for improvement include adding parameters related to morphology and orientation, as well as combining AI with traditional rigid registration methods.

## 3 Conclusion

This study shows that it is possible to reconstruct 3D shapes from magnetic data using deep learning, with encouraging accuracy for a first step. The integration of additional constraints and hybrid approaches paves the way for functional and generalizable prototypes, including for shapes with complex deformations.

## References

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