Reconstruction of 3D shapes from magnetic data for orthopedic orthoses using deep learning

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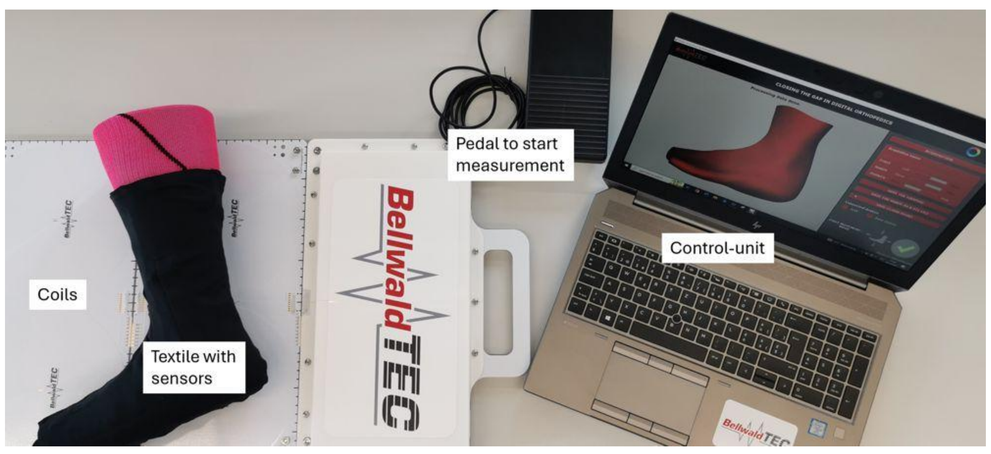
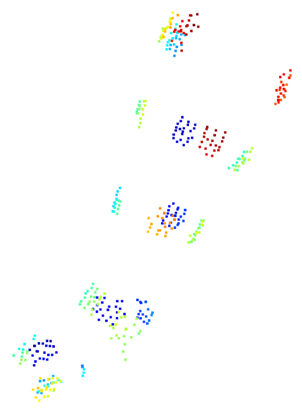
The design of **customized orthoses** relies on the ability to accurately reconstruct the three-dimensional geometry of the patient's limb. Traditional 3D scanning methods rely primarily on optical scanners or photogrammetry techniques, offering high accuracy but requiring expensive equipment, technical 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.

Data pre-processing

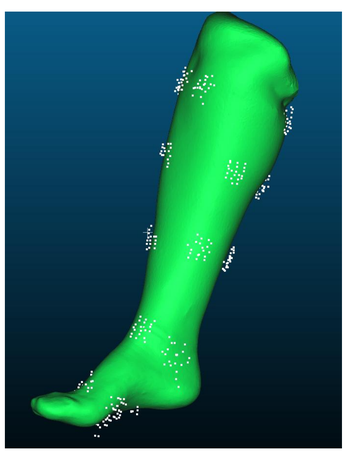
Current method
Scotchcast bandages



Prototype [4]



Magnetic sensor positions



Optical scan [green]
point clouds magnetic sensors [white]

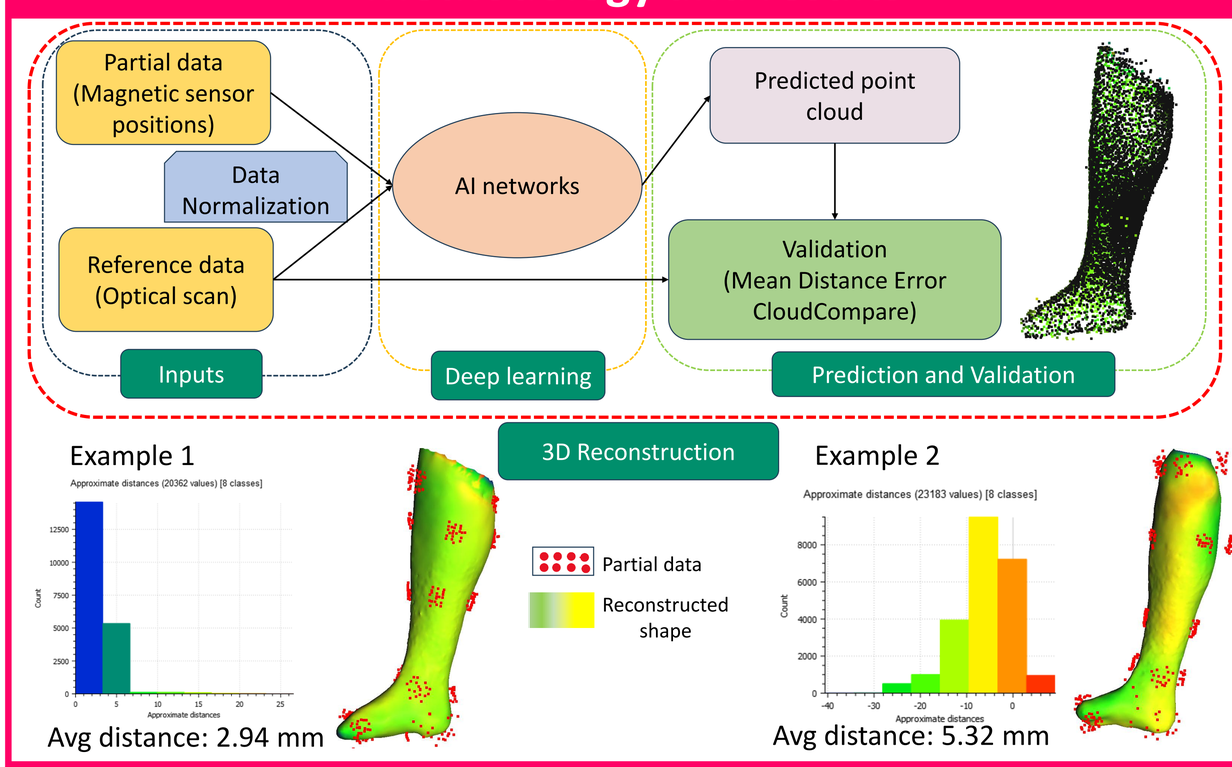
Our method
from magnetic sensor positions to shape reconstruction

- Cleaning outliers from noisy sensor data
- Data normalization

- Alignment between magnetic sensor positions and optical scan of the shape

Objective → Reconstruct the 3D shape from point clouds predicted by an AI model → a completion of missing points.

Methodology and results



Conclusion and perspectives

→ This work demonstrates the feasibility of reconstructing 3D geometries from magnetic field data using deep learning.
→ The proposed model achieves promising accuracy, validating the approach as a viable first step toward data-driven magnetic reconstruction.

→ Future work will focus on integrating **physical and geometric constraints** to enhance robustness and generalization.
→ **Hybrid models** combining data-driven learning and physics-informed formulations could improve interpretability and precision.
→ The method could be extended to **objects exhibiting complex, non-rigid deformations**, enabling broader industrial and scientific applications.

References

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