MagShield: Towards Better Robustness in Sparse Inertial Motion Capture Under Magnetic Disturbances
– Supplementary Material –

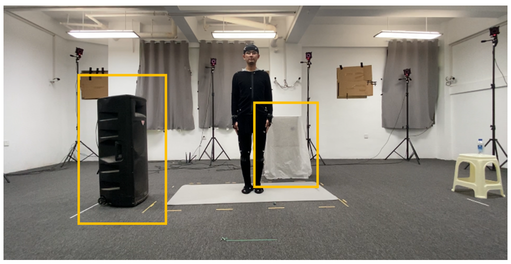

Figure 1. Data collection environment

Method	SIP Err	Ang Err	Pos Err	Mesh Err
		PNP		
ESKF6D	30.19	30.62	10.63	13.21
Noitom	27.36	25.02	9.03	10.73
baseline	26.63	24.65	8.99	10.86
ours	**24.19**	**20.23**	**8.17**	**9.74**

Table 1. Quantitative comparisons between different IMU orientation estimation methods on MagIMU dataset.

A. Information About MagIMU Dataset

This dataset includes 5 subjects, consisting of 4 males and 1 female, with heights ranging from 1.70 to 1.85 meters. It comprises a total of 26 sequences, each lasting approximately 3 minutes, with each sequence focusing on a fixed theme. These themes include: warm-up exercises, sports activities, boxing, tai chi, walking, and freestyle. These motions are relatively diverse and somewhat challenging.

To artificially create an environment with magnetic field interference, we placed some ferromagnetic materials in the motion capture room, including two iron cabinets and an iron speaker (Fig. 1). To create more diverse magnetic field environment, we changed the placement of objects for different subjects. We also asked volunteers to perform at various locations within the venue.

The volunteers wear 6 IMUs and an optimal MoCap suit to record the following data: (1) IMU data: time stamp, IMU raw measurements, and official readings provided by sensor manufacturer, at 100FPS. (2) MoCap data: SMPL [1] pose and translation derived from the optimal MoCap system, at 60FPS. We use Noitom AxisLab [3] to record IMU data and NOKOV [4] optimal MoCap system to record MoCap data. We manually aligned the start of the IMU and MoCap data for each sequence.

We observed that in environments with significant magnetic interference, IMUs are highly susceptible to magnetization. We intentionally avoided such situations during the data collection process by calibrating the magnetometer approximately every 15 minutes.

B. Comparison With Commercial IMU Filter

We compare commercial orientation estimation methods provided by Noitom [3] with the baseline method and our proposed method. Introduction to baseline and our method please refer to the main text. We fed the IMU readings from these three methods to PNP [7] and evaluate their performace on MagIMU dataset. Results are shown in Tab. 1. Comparing the second and third rows, our baseline method matches or even surpasses the accuracy of the black-box commercial orientation estimation method, demonstrating its competence. Comparing the second and fourth rows, our proposed method significantly better than the commercial one, indicating that our proposed method offers superior performance in terms of accuracy and reliability.

C. Discussion On 6-axis IMU Filter

The 6-axis IMU orientation estimation method refers to one that does not utilize magnetometer measurements. Such algorithms are immune to magnetic field interference but tend to accumulate errors. We conduct quantitative tests on ESKF6D, a modified ESKF [5] operating without magnetometer measurements. As shown in Tab. 1, its performance is significantly inferior to the baseline, i.e., ESKF9D. In addition, we perform a qualitative comparison with Mocopi [2], a commercial product that also employs 6-axis IMU orientation estimation. Our proposed method, when integrated with PNP, achieves higher accuracy than Mocopi (see the supplementary video). Note: Due to differences

Method	SIP Err	Ang Err	Pos Err	Mesh Err
TotalCapture (Official Calibration)				
PNP	11.35	11.10	4.89	5.60
+ours	11.36	11.11	4.89	5.61
TotalCapture (DIP Calibration)				
PNP	10.89	10.45	4.74	5.45
+ours	10.90	10.47	4.75	5.47

Table 2. Quantitative comparisons on pose accuracy between the origin PNP and its enhanced version on local pose.

in IMU sensors and motion capture algorithms, this experiment does not serve to demonstrate the accuracy of our IMU estimation itself, but rather reflects the overall system accuracy.

D. Performance On Clean IMU Data

We evaluate our method on TotalCapture [6] dataset to ensure that it does not introduce adverse effects in environments with minimal magnetic interference. we conduct the comparison between origin PNP [7] and PNP enhanced by our method. As shown in Tab. 2, our method achieves performance comparable to previous methods, indicating that our method can serve as an always-on component across different environments.

References

[1] Matthew Loper, Naureen Mahmood, Javier Romero, Gerard Pons-Moll, and Michael J Black. Smpl: A skinned multi-person linear model. *ACM Transactions on Graphics*, 34(6), 2015. 1

[2] Mocopi. Sony mocopi 3d motion capture system, 2025. 1

[3] Noitom. Noitom motion capture systems, 2025. 1

[4] NOKOV. Nokov motion capture solutions, 2025. 1

[5] Joan Sola. Quaternion kinematics for the error-state kalman filter. *arXiv preprint arXiv:1711.02508*, 2017. 1

[6] Matthew Trumble, Andrew Gilbert, Charles Malleson, Adrian Hilton, and John Collomosse. Total capture: 3d human pose estimation fusing video and inertial sensors. In *Proceedings of 28th British Machine Vision Conference*, pages 1–13, 2017. 2

[7] Xinyu Yi, Yuxiao Zhou, and Feng Xu. Physical non-inertial poser (pnp): modeling non-inertial effects in sparse-inertial human motion capture. In *ACM SIGGRAPH 2024 Conference Papers*, pages 1–11, 2024. 1, 2