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# A Feature-Based Filtering Algorithm with 60GHz MIMO FMCW Radar for Indoor Detection and Trajectory Tracking

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# Outline

- Introduction
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- Experiments and Results
- Conclusion

# Introduction

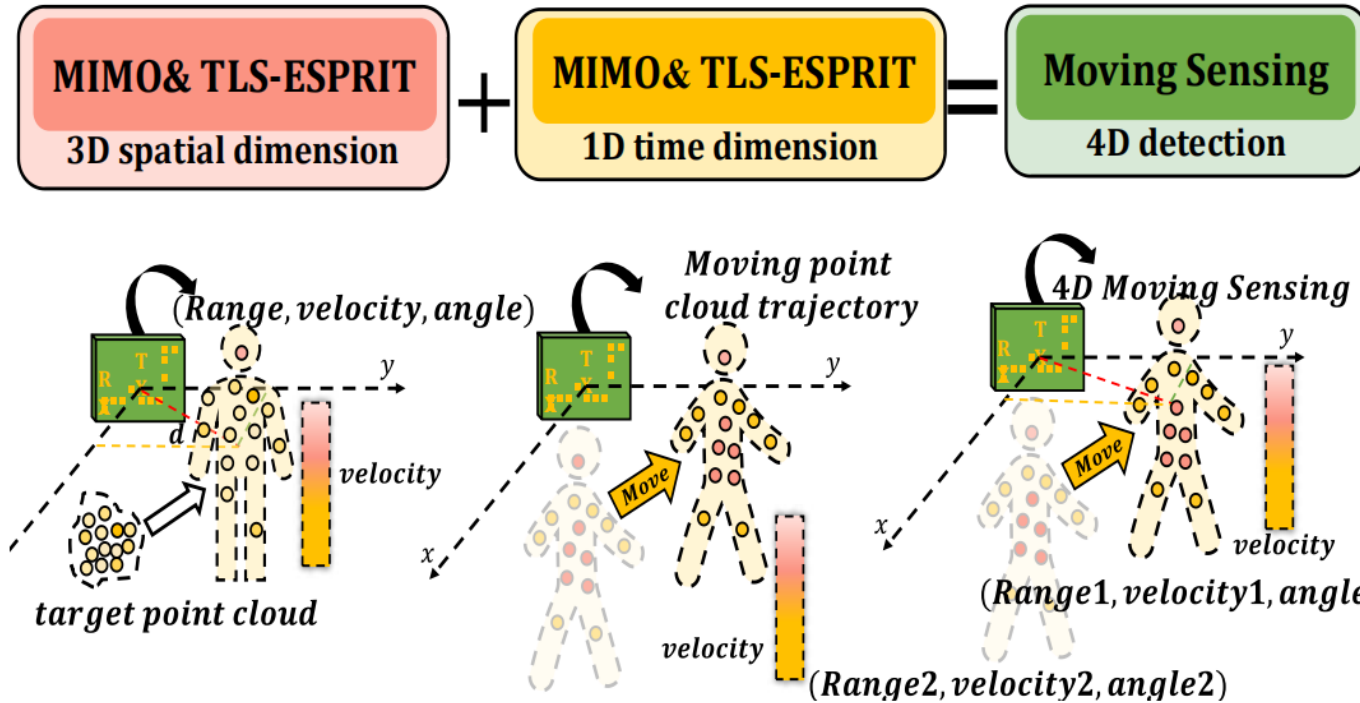


Fig.1. Schematic diagram of indoor human body positioning and motion tracking.

- This article is based on the generation of point clouds from 60GHz MIMO FMCW radar echo signals, combined with super-resolution DoA algorithm to achieve human body positioning and trajectory tracking.

## Feature-Based Filtering Algorithms

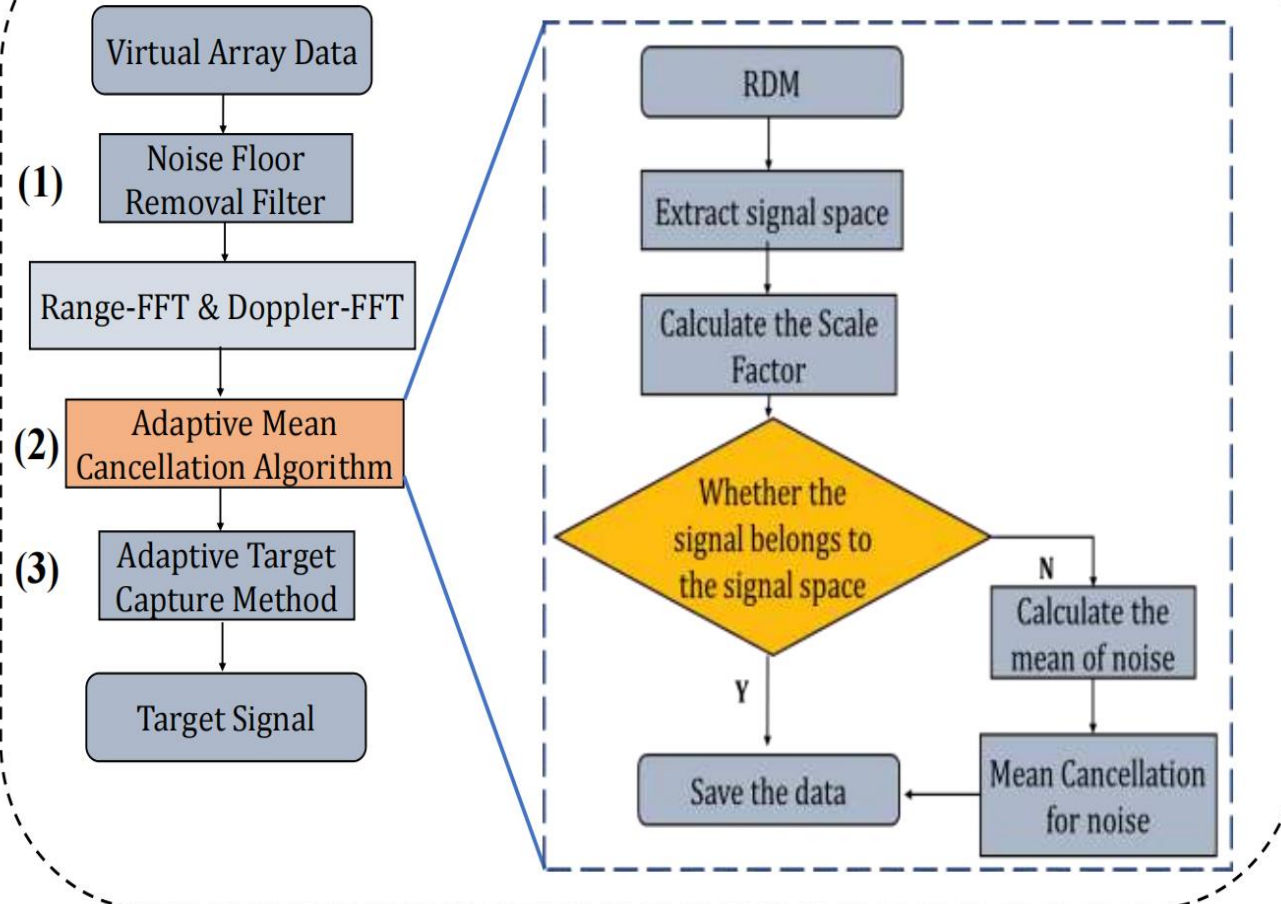
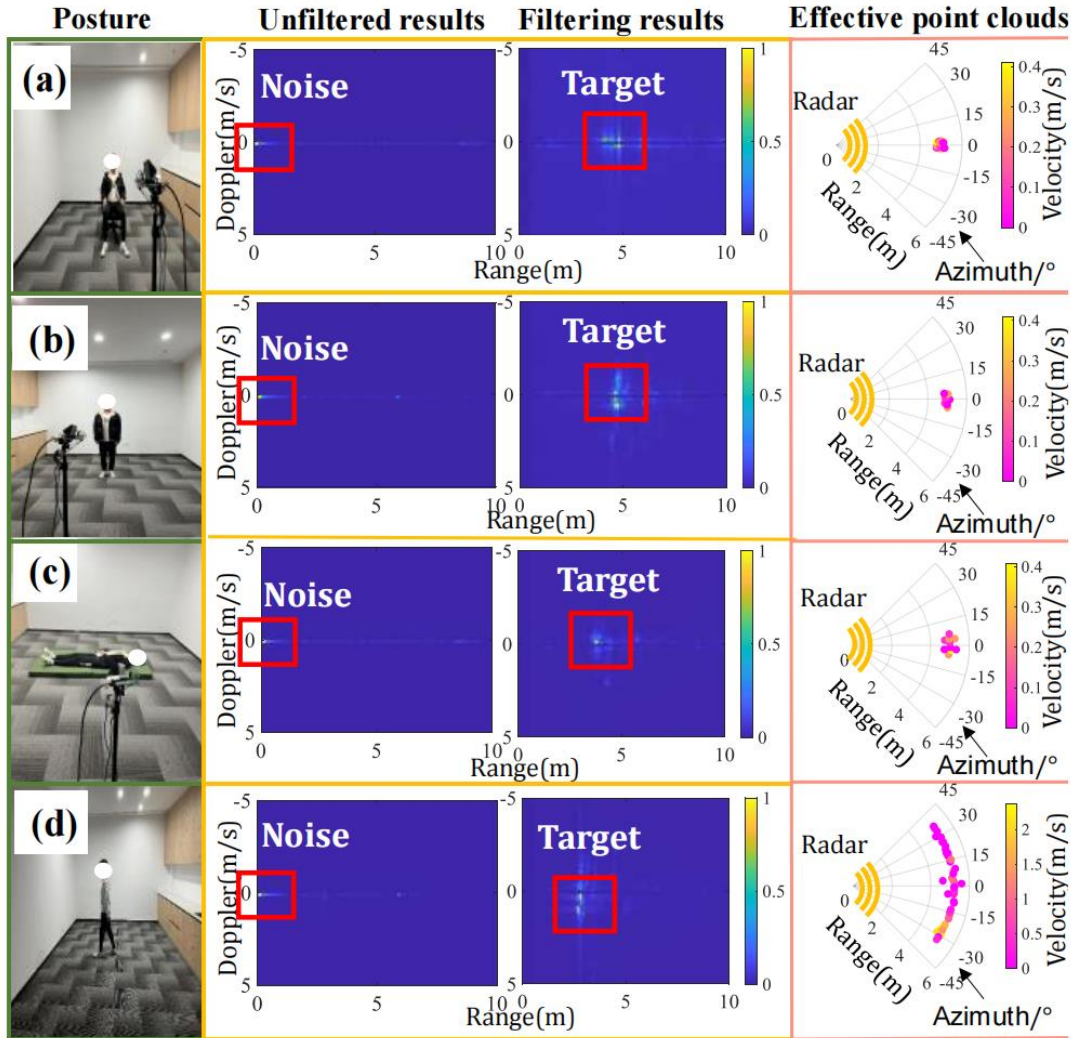


Fig2. Flow chart of Adaptive Mean Cancellation Algorithm and Feature-Based Filtering Algorithm.

- In the first step, the background noise embedded in the data from every virtual array channel is removed. Then a 2D fast Fourier transform is performed to obtain the Range-Doppler Map.
- In the next step, adaptive mean cancellation algorithm is performed on all data points to obtain a purer RD map with only valid targets.
- Finally, the effective target is obtained through the adaptive target capture method.



- In Figure 3, the experimental test results under four different human postures are presented. In the original signal, the target is submerged in the noise. After the signal processing link proposed in this paper, the target is highlighted, and an effective point cloud image of the target is generated at the same time.

Fig3. Experiment results of indoor human target detection: (a)sitting; (b)standing; (c)lying and(d) moving.



# Experiments and Results

Table 1. Comparison of the proposed method and classical methods in terms of signal-to-noise ratio and number of effective point clouds.

| Posture  | $\rho_{raw}/\text{dB}$ | $\rho_{final}/\text{dB}$ | $N_{raw}$ | $N_{final}$ |
|----------|------------------------|--------------------------|-----------|-------------|
| Standing | -74.95                 | 18.69                    | 0         | 12          |
| Sitting  | -69.77                 | 22.27                    | 0         | 10          |
| Lying    | -89.27                 | 16.15                    | 0         | 8           |
| Moving   | -68.59                 | 22.19                    | 0         | 25/frame    |

- $\rho_{raw}/\rho_{final}$  represents the signal strength of the original signal and the final signal,  $N_{raw}/N_{final}$  represents the number of effective point clouds generated by the original signal/the final signal. From Table 1, it can be seen that there has been a significant improvement in all performance aspects.

# Conclusion

- In this paper, a new feature-based filtering algorithm to enhance the human target signal in indoor detection is proposed. SNR improvement all above 90dB. Based on the 60GHz MIMO FMCW radar, the 3D point clouds of the static human body and the 4D point clouds of the dynamic human body can be obtained. It has been verified by many experiments that this algorithm can effectively highlight the human target signal, remove interference noise, and locate and track the target with high precision.