https://ictc.org

ICTC 2025

THE 16th INTERNATIONAL CONFERENCE ON
ICT CONVERGENCE

“AI-native ICT Convergence for a sustainable future”

October 14-17, 2025 | Lotte Hotel Jeju, Jeju Island, Korea

Final Program

Organized by

KICS
The Korean Institute of
Communications and
Information Sciences

Technically Co-Sponsored by

IEEE

IEEE ComSoc
IEEE Communications Society

IEICE
Communications
Society

(one6G)

Patrons

Ministry of Science and ICT

ETRI
Electronics and Telecommunications
Research Institute

IITP
Institute of Information & Communications
Technology Planning & Evaluation

KOFST

제주관광공사
JEJU TOURISM ORGANIZATION

SAMSUNG

LG U+

SK telecom

HUAWEI

kt

LG Electronics

ERICSSON

Qualcomm

This work was supported by the Korean Federation of Science and Technology Societies(KOFST) grant funded by the Korean Government.

Technical Paper Sessions

P06-17 UAV-BS Assisted User Localization Considering Bearing Observability in mmWave Systems
Juhyung Lee (ROKAF, Korea (South) & Ajou University, Korea (South)); Jiyoon Noh and Dongmin Kim (ROKAF & Ajou University, Korea (South)); Jae Sung Lim (Ajou University, Korea (South))

P06-18 Localization Performance Analysis of UAV-based Integrated Sensing and Communication System
Dongmin Kim and Jiyoon Noh (ROKAF & Ajou University, Korea (South)); Juhyung Lee (ROKAF, Korea (South) & Ajou University, Korea (South)); Jae Sung Lim (Ajou University, Korea (South))

P06-19 Scalable Sliding Resource Allocation in C-V2X Mode-3 with Multi-Agent Reinforcement Learning
Moin Ali (Tech University of korea, Korea (South)); Su Min Kim and Junsu Kim (Tech University of Korea, Korea (South))

P06-20 USD-Based 3D Model Database and Spatial Configuration Technologies for Digital Twins
Myeongseop Kim and JungWook Wee (Korea Electronics Technology Institute, Korea (South))

P06-21 Enhancing Wi-Fi RSSI-Based Indoor Positioning with a Covariance-Weighted Distance Metric
Youngjin Lee (University of Science and Technology, Korea (South) & Electronics and Telecommunications Research Institute, Korea (South)); Hansol Park (University of Science and Technology (UST), Korea (South) & Electronics and Telecommunications Research Institute, Korea (South)); DukKyun Woo (ETRI, Korea (South)); Jaejun Yoo (Electronics and Telecommunication Research Institute, Korea (South))

P06-22 Federated Learning and Lightweight Blockchain for Resilient UAV Communication Against PNT and Model Poisoning Attacks
Dong Seong Kim and Simeon Okechukwu Ajakwe (Kumoh National Institute of Technology, Korea (South))

P06-23 AI-vOLT: Multi-Stage Agentic Translation from Operator Intent to Executable PON Procedures
Chansung Park (ETRI, Korea (South)); YongWook Ra (Electronics and Telecommunications Research Institute, Korea (South)); Hwan Seok Chung (ETRI, Korea (South))

P06-24 Edge-Based Multimodal Crowd Monitoring System for Outdoor Environments
Taemin Hwang, Won Gi Choi, Sohyeon Kim, Jinyoung Lee and Younghwan Jeong (Korea Electronics Technology Institute, Korea (South)); Minjoon Kim (School of Electrical and Computer Engineering University of Seoul, Korea (South))

P06-25 Quantum-Enhanced Edge Intelligence: Bridging Quantum Computing and Distributed AI
Hoa Tran-Dang (Kumoh National Institute of Technology, Korea (South) & IT Convergence Engineering, Korea (South)); Dong Seong Kim (Kumoh National Institute of Technology, Korea (South))

P06-26 Toward Heterogeneity-Aware Striping in Lustre
Sooyoung Lim, Jaegi Son and Dongmin Kim (Korea Electronics Technology Institute, Korea (South))

P06-27 Multi-Stage Intrusion Detection System for 5G Security Resilience
Hyun Jin Kim, Jung Tae Kim and Jisoo Shin (Electronics and Telecommunications Research Institute, Korea (South)); Yongyoon Shin (ETRI, Korea (South)); HoonKi Lee (Electronics & Telecommunications Research Institute, Korea (South))

P06-28 Multi-Object Count Estimation in OFDM Radar Systems Using YOLOv8 Based on Subcarrier Sparsity
Euna Ko, Soyeon Jeon and Eui-Rim Jeong (Hanbat National University, Korea (South))

P06-29 Development of Small Data-Based Mathematical Models for Industrial AI Applications
Ji-yong Hwang (Electronics and Telecommunications Research Institute, Korea (South)); Hyun-Woo Oh (Electronics & Telecommunications Research Institute, Korea (South))

P06-30 A COLREG-compliant Local Path Planning for Unmanned Surface Vehicle
Jiwoo Jung (Donnguk University, Korea (South)); Jinwoo Choi (KRISO, Korea (South)); Seungbeom Seo and Yu-Cheol Lee (Dongguk University, Korea (South))

Multi-Object Count Estimation in OFDM Radar Systems Using YOLOv8 Based on Subcarrier Sparsity

1st Eun-A Ko
dept. of Artificial Intelligence
Hanbat National University
Daejeon, Republic of Korea
dms1163@naver.com

2nd So-Yeon Jeon
dept. of Artificial Intelligence
Hanbat National University
Daejeon, Republic of Korea
jeonsso1109@gmail.com

*Eui-Rim Jeong
dept. of Artificial Intelligence Software
Hanbat National University
Daejeon, Republic of Korea
erjeong@hanbat.ac.kr
(corresponding author)

Abstract*—This paper analyzes the impact of subcarrier sparsity on multi-object count estimation performance in OFDM radar systems, which are emerging as a core technology of Integrated Sensing and Communication (ISAC), by utilizing the YOLOv8 object detection model. The simulation results demonstrated that subcarrier sparsity did not have a substantial impact on the accuracy of multi-object count estimation under equivalent symbol count conditions. However, under identical parameter conditions, as subcarrier sparsity diminishes, the representable range axis in the 2D Range-Doppler map proportionally contracts. Conversely, the number of OFDM symbols has been shown to significantly enhance estimation performance, particularly in low-SNR environments. These results suggest that symbol number optimization is a key consideration in the design of future communication-sensing fusion systems.

Keywords*—OFDM radar, YOLOv8, multi-object count estimation, subcarrier sparsity, integrated sensing and communication (ISAC)

I. INTRODUCTION

Recently, sensing technology for precise environmental perception has become increasingly important in various fields of application, such as autonomous vehicles, smart cities, drones, and the Internet of Things (IoT). As high-speed data transmission and high-precision sensing are increasingly required simultaneously, the scarcity and conflict of frequency resources have intensified. Consequently, the efficient sharing and reuse of frequencies have emerged as critical challenges. In order to address these challenges, sixth-generation (6G) mobile communications are expected to adopt Integrated Sensing and Communication (ISAC) as a core technology [1]. ISAC enables simultaneous data transmission and object detection without requiring dedicated spectrum allocation, thereby significantly improving spectral efficiency. Among ISAC approaches, Orthogonal Frequency Division Multiplexing (OFDM)-based radar systems are particularly promising because of their high compatibility with existing communication infrastructures. These systems can detect moving objects without requiring additional channel estimation or a spectrum exclusively allocated to sensing, thereby enabling the concurrent operation of communication and radar functionalities.

Concurrently, advances in deep learning-based object detection have led to the emergence of high-performance real-time algorithms such as YOLOv8. With its anchor-free architecture and multi-scale prediction capability, YOLOv8 can effectively detect objects of various sizes, making it highly applicable to radar signal processing. Prior studies have compared the performance of YOLOv5 and YOLOv8 under conditions where all subcarriers are utilized [2]. Building on this foundation, the present study extends the investigation by analyzing the effect of subcarrier sparsity on multi-object count estimation in OFDM radar systems.

II. OFDM RADAR SYSTEM MODEL

The structure of the OFDM radar system is illustrated in Fig. 1. At the transmitter, the modulated signal is transformed into time-domain OFDM symbols using the Inverse Fast Fourier Transform (IFFT). A cyclic prefix (CP) is then appended before transmission over the wireless channel. The transmitted signal is simultaneously delivered to the communication receiver and reflected by surrounding objects, where it is exploited as radar signals. At the receiver, the CP of the reflected signal is removed, and a Fast Fourier Transform (FFT) is applied to convert it back into the frequency domain. By accumulating multiple OFDM symbols and applying a two-dimensional FFT, a 2D Range-Doppler map is generated.

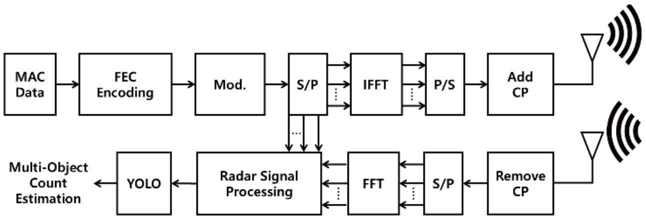

Fig. 1. OFDM Radar System Model.

III. PROPOSED MULTI-OBJECT ESTIMATION ALGORITHM

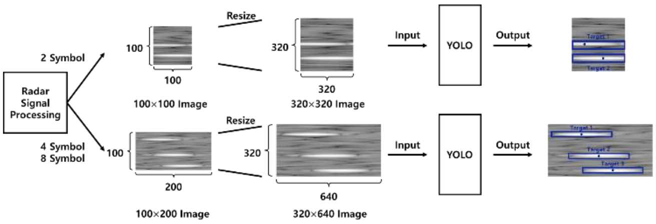

Fig. 2. Block Diagram of Multi-Object Count Estimation Based on YOLOv8.

Figure 2 illustrates the overall flow of the proposed multi-object estimation algorithm. The algorithm uses a 2D Range-Doppler map generated by the OFDM radar system as the input to the YOLOv8 model, which estimates the number of objects.

In this study, radar performance is prioritized, and instead of employing the conventional resource allocation method used in communication systems, a sparse subcarrier allocation scheme is applied. In this scheme, only a subset of subcarriers is selectively activated at equal intervals within the total bandwidth. The subcarrier sparsity is defined as in (1), where N_{active} denotes the number of active subcarriers and N_{total} the total number of subcarriers.

$$Sparsity = \frac{N_{active}}{N_{total}} \tag{1}$$

Under identical parameter conditions, reducing subcarrier sparsity increases the effective subcarrier spacing, which reduces the maximum unambiguous range. Consequently, the representable range axis of the 2D Range-Doppler map is proportionally contracted. Figure 3 visualizes the 2D Range-Doppler maps according to the number of OFDM symbols and subcarrier sparsity levels.

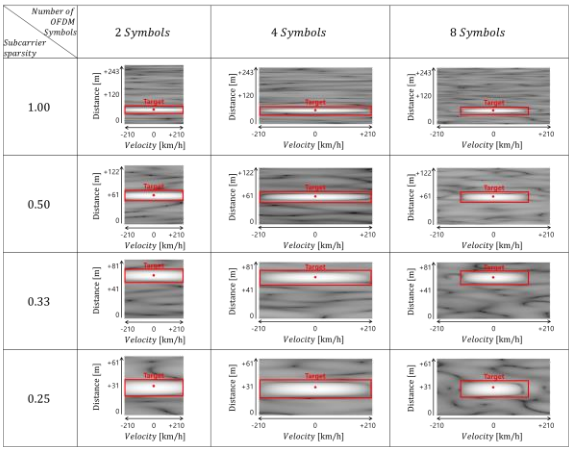

Fig. 3. Range-Doppler Maps According to the Number of OFDM Symbols and Subcarrier Sparsity.

IV. SIMULATION ENVIRONMENT AND RESULTS

The simulation data was generated using MATLAB, and the YOLO model was trained and evaluated with a TensorFlow-based deep learning framework. The main parameters are summarized in Table 1.

TABLE I. SIMULATION ENVIRONMENT

Parameter	Value
OFDM Symbol Duration	35.74 us
Sampling frequency	122.88 MHz
IFFT(FFT) size	4096
Bandwidth	40 MHz
Center frequency	28 GHz
Length of CP	296
Num. of OFDM symbol	2, 4, 8
2D FFT size	2048x128, 2048x256
Cropped region size	100x100, 200x100
Subcarrier sparsity	1.00, 0.50, 0.33, 0.25
Num. of targets	1~5
SNR range	-10~20dB

Fig. 4 illustrates the multi-object count estimation accuracy as a function of the number of OFDM symbols and subcarrier sparsity across different SNR values. The results show that changing the subcarrier sparsity levels to 1.00, 0.50, 0.33, and 0.25 produces little difference in estimation accuracy, indicating that the number of OFDM symbols has a greater impact on radar performance than subcarrier sparsity. Increasing the number of symbols from 2 to 8 significantly improves estimation accuracy, with the improvement being especially pronounced in low-SNR environments.

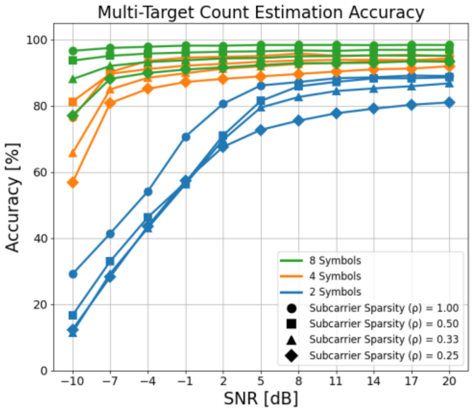

Fig. 4. Performance of Multi-Object Counting Based on Subcarrier Sparsity and Number of OFDM Symbols.

V. SIMULATION RESULTS AND CONCLUSIONS

In this paper, we analyzed the impact of subcarrier sparsity on multi-object count estimation in an OFDM radar system using the YOLOv8 model. The proposed approach employs 2D Range-Doppler maps, generated from OFDM signals reflected by targets, as inputs to YOLOv8 to effectively estimate both the presence and the number of multiple objects.

Simulations were conducted under various subcarrier sparsity levels, OFDM symbol lengths, and SNR conditions. The results demonstrate that subcarrier sparsity has little effect on estimation accuracy; however, as sparsity decreases under identical parameter settings, the representable range axis in the 2D Range-Doppler map becomes proportionally constrained. In contrast, the number of OFDM symbols has a significant impact on performance, with multi-object estimation accuracy improving considerably as the symbol count increases, especially in low-SNR environments. These findings suggest that symbol optimization should be a primary consideration in the design of future ISAC systems.

ACKNOWLEDGMENT

This research was supported by the MSIT(Ministry of Science, ICT), Korea, under the National Program for Excellence in SW), supervised by the IITP(Institute of Information & communications Technology Planing & Evaluation) in 2025 (2022-0-01068)

REFERENCES

[1] F. Liu, Y. Cui, C. Masouros, J. Xu, T. X. Han, Y. C. Eldar, and S. Buzzi, “Integrated sensing and communications: Toward dual-functional wireless networks for 6G and beyond,” IEEE J. Sel. Areas Commun., vol. 40, no. 6, pp. 1728–1767, Jun. 2022, doi: 10.1109/JSAC.2022.3143546.

[2] E. A. Ko, S. Y. Jeon, and E. R. Jeong, “Multi-object detection and range/velocity estimation in OFDM radar system using YOLOv8,” in Proc. Symp. Korean Inst. Commun. Inf. Sci. (KICS), Jeju, Korea, Jun. 2025, pp. 277-278.