Response to reviewer comments

We are sincerely grateful to the editor and reviewers for their valuable time spent on reviewing our manuscript. The comments are very helpful and valuable, and we have addressed the issues raised by the reviewers in the revised manuscript. Please find our point-by-point response (in blue font) to the comments (in black font) raised by the editor and reviewers.

Referee: 1

COMMENTS TO THE AUTHOR(S)

1、Actual vehicle demonstrations are limited throughout the text, with real-world vehicle images only provided in the final section on unmanned cruise functionality. Could you provide additional images or videos of testing to further validate the experimental results?

Response: Thank you for your professional and meticulous suggestion. Certainly, the Fig. 1 demonstrates the vertical detection and unmanned cruise experiments currently being conducted. The unmanned cruise videos are available in the attachment.

Fig. 1

2、In the introduction, the need for uninterrupted cruise detection during regional pollution prevention and control actions, which can lead to a significant loss of operator energy. This has resulted in a significant increase in labor costs for existing manned cruise detection systems. Can you give an example or cite a specific case for illustration?

Response: Thank you for your professional and meticulous suggestion. In the revised manuscript, we mentioned that mobile detection can be carried out in urban areas and a certain geographical region, and also cited relevant literatures. In the cited studies, continuous driving is required, which leads to driver energy loss and increases labor costs. (refer to lines 65-69 in the revised manuscript)

3、In the second part on system and methods, the path planning and obstacle avoidance strategies for the unmanned vehicle all adopt relatively conventional approaches. I wonder if the author has conducted other more sophisticated path planning method investigations in subsequent research.

Response: Thank you for your professional and meticulous suggestion. Future implementations will utilize advanced path-planning algorithms and refined obstacle-avoidance strategies. unmanned cruise experiments in different environments are also to be carried out. It is also mentioned in the conclusions section of the manuscript. (refer to lines 329-334 in the revised manuscript)

4、The relationship between the depolarization ratio stratification phenomenon and dust input has not been validated by integrating satellite meteorological data. Can different data be used to verify the weather conditions of the day?

Response: Thank you for your valuable and professional feedback.

The Aerosol Optical Depth Analysis data was extracted from the MERRA-2 reanalysis dataset during February 22–24. In the revised manuscript, we compared the particulate matter concentration data from the stations with the Range-corrected signal and found that the variation of particulate matter concentration was consistent with that of the Range-corrected signal. And the MERRA-2 data corroborates that Hefei experienced an aerosol pollution process during the period from the 22nd to the 24th. Through vertical detections and comparative analysis, we can obtain a more refined vertical distribution of aerosols from the LiDAR results. (refer to lines 241-263 in the revised manuscript)

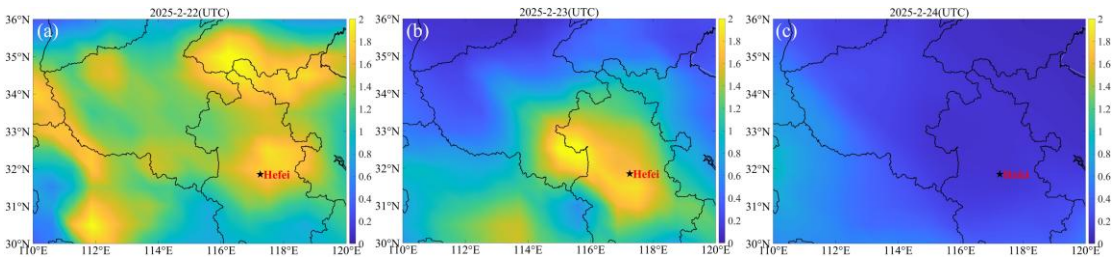

Fig. 2

5、In the introduction, it is mentioned that scanning detection is divided into horizontal scanning and cone-scanning Detection. However, only cone-scanning detection is

mentioned in the manuscript. Can horizontal scanning experiments be added to illustrate the detection capability of the system?

Response: Thank you for your valuable and professional feedback. Due to the limitation of the experimental site, the horizontal scanning detection will be obstructed by higher buildings, and the experimental effect is not very good. The system is equipped for horizontal scanning (see attached video). In subsequent phases, we will identify suitable sites to conduct horizontal scanning detection experiments.

6、The unmanned intelligent cruise detection experiments have only been conducted in small-scale navigation within the campus. I wonder if the author has any plans for subsequent experiments in different environments and road conditions.

Response: Thank you for your valuable and professional feedback. unmanned cruise experiments in different environments are also to be carried out. It is also mentioned in the conclusions section of the manuscript. (refer to lines 329-334 in the revised manuscript)

7、Line110: 'range-corrected signal' should be 'Range-corrected signal'?

Response: Thank you for your valuable and professional feedback. The revisions have been incorporated into the manuscript. (refer to line 119 in the revised manuscript)

8、Line111: modify ‘X’ to ‘X(z)’

Response: Thank you for the suggestion. The revisions have been incorporated into the manuscript. (refer to line 120 in the revised manuscript)

9、Line 173, label (a) in the legend of Fig. 3 is not explained.

Response: Thank you for the suggestion. The revisions have been incorporated into the manuscript. (refer to line 303 in the revised manuscript)

10、The meanings of the parameters in the table on line 175 are not explained. Please indicate them.

Response: **Thank you for your valuable and professional feedback. The parameters in the table have been explained in the revised manuscript. (refer to lines 144-147 in the revised manuscript)**

"In Formula (4),$v_{max}$is the maximum permissible speed during driving, a_{max} is the maximum acceleration allowed during driving, j_{max} is the maximum rate of change of acceleration allowed during driving, $\varphi_{max}$is the maximum allowable front wheel equivalent swing angle, $\omega_{max}$is the maximum allowable front wheel swing angle angular velocity."

11、line 196: the meanings of $PM_{2.5}$/PM_{10} is not explained.

Response: **Thank you for the suggestion. The revisions have been incorporated into the manuscript. (refer to lines 253-255 in the revised manuscript)**