Response to Reviewer’s Comments

We would like to thank the editor and all the reviewers of our submitted manuscript Sensors-516766, entitled “Low-Slow-Small (LSS) Target Detection based on Micro Doppler Analysis in Forward Scattering Radar Geometry”. Here we have modified the paper for resubmission according to the reviewer’s suggestions and comments.

The authors have managed to answer almost all the reviewer comments and suggestions.

REVIEWER 3

General comment
Interesting paper showing both theory and measurements. Both the simulated and the measurement results are very interesting but they are not fully explained.

1) The reviewer’s comment:
“The reviewer after recommending the paper suggested some improvement in some areas; example, in Fig 3. - The model seems to be limited to the blade tips (and it should be clearly stated). In many cases also blade flashes are visible. Electromagnetic modelling will be welcome”

Response:
Firstly, we would like to thank the reviewer for the comments and important suggestion, we really appreciate that. Yes, the reviewer is right; Fig 3 is limited to response due to blade tips. This information was stated in line 214-216 of the updated version of the manuscript. It is also made clear while explaining the simulated result in line 302 and the validation in line 404-405. The electromagnetic modelling was also conducted by simulating the forward scattering RCS of three different blades type for different aspect angle by using computer simulation technology (CST). The result was interesting and was published in the “STRIDE Defence Science & Technology Journal”

2) The reviewer’s comment:
“Fig 7. Do we observe Doppler effect or frequency of rotor – there are no discussion”.

Response:
Thank you for highlighting this issue, we accept that this paragraph has some shortage in explanation regarding the Doppler effect. Actually Doppler effect due to the rotating blade was observed not the frequency of the rotor. The discussion for “Fig 7” “Now Fig 9” in the updated version of the manuscript comes before the figure as can be seen in line 452-459. For clarity, the Figure is now referenced within the text.
3) **The reviewer’s comment:**

“It seems that 2-nd and 3-rd harmonics are observed during deceleration of rotor but not during other phases – why? This effect should be discussed”.

**Response:**

Thank you for highlighting this issue, we accept that the harmonics effect was not discussed. The 2nd and 3rd harmonics were due to the volume scattering of the surrounding, and occurred while decelerating, due to the rotors free speed and the time taken to stop. This one of the motivating factor of the anechoic chamber experiment, in an attempt to minimize the harmonics and other external effect.

4) **The reviewer’s comment:**

“In the sentence “A total integration time of 15 s” author mentioned “integration” but it is not explained what kind of integration was used. And picture 7 shows only 9seconds”.

**Response:**

Thank you for highlighting this issue, we accept that this paragraph has an unclear information that may be misleading. This is an over sight, we actually refer to “observation time”. Fig 7 which is now “Fig 9” in the updated version of the manuscript shows only 9 s because the transition time of “2 s” out of “5 s” for both start and stop were captured, while the remaining “5 s” is for “On” state. This was explained in line 457-459 (the 3-states transition of the blades, i.e. Off-On-Off. The blade was initially in ‘Off’ position, then switched ‘On’ and then ‘Off’ again for 5 s each.)

5) **The reviewer’s comment:**

“Fig. 8 what is the difference between 8a and 8b, 8c and 8d”.

**Response:**

The difference between 8a and 8b, 8c and 8d which is now “Fig 10a and 10b” in the updated version of the manuscript is that, Fig 10a is for 1-rotor and 10b for 2-rotors signatures while the blade is “Facing-Rx” scenario while Fig. 10c is for 1-rotor and 10d for 2-rotors signatures while the blade is “Facing-Up” scenario. These was stated in the Figure caption and the explanation of the Figure 10, and the explanation in line 515-520.

6) **The reviewer’s comment:**

“Why on 8b there are two different frequencies? Why on 8a is a line around 20 Hz? What was carrier frequency?”

**Response:**

The Fig 8a and 8b are now “Fig 10a and 10b” in the updated version of the manuscript. There are two different frequencies in Fig 10b because of 2-rotors with different geometrical positions as described in Fig
2 and equation (4) and (5), line 172-184. The 20 Hz line is harmonics due to reflection and this was minimized during the anechoic chamber experiment. The frequency used is 3 GHz.

7) The reviewer’s comment:
“Similar questions can be raised to all presented results where more care is needed to describe the conditions of measurements (carrier frequency, rotor speed, length of the blades) and obtained results”.

Response:
The carrier frequency used is now stated in the updated version of the manuscript for all cases e.g. line 400, line 412, line 483, line 524, line 551, line 588, line 619 etc. For the rotor speed, an approximate rotor speed of 36 r/s and blade length is 0.12 m were used; this was now stated in line 391-392.

Regards
RSA Raja Abdullah