In order to verify the algorithm, already fourier transformed simulated radar image and the real radar image are used respectively. First of all we want to have an intuitive looking at amplitude of targets and noise, from this perspective simulator is adjusted to have a similar noise level to real data, shown in fig.1. After that we want to have binarized radar image, in order to filter everything except targets, which is done in algorithm steps 6 to 8, and we name this binarized radar image as fig_eval, shown in fig.2 & 3. Then we want to have the target data obtained from OS-CFAR also to be binarized, which is done in algorithm steps 11 to 13, and we name this binarized target data image as fig_comp. To compare the two binary image, the cosine similarity function is used corresponding to algorithm steps 1 to 3. The image with the maximum similarity is saved as fig_final, shown in fig.4, meanwhile the indexes of the double loop are saved as the alpha and k factor. As we can see from fig.4, the performance of this algorithm is good.

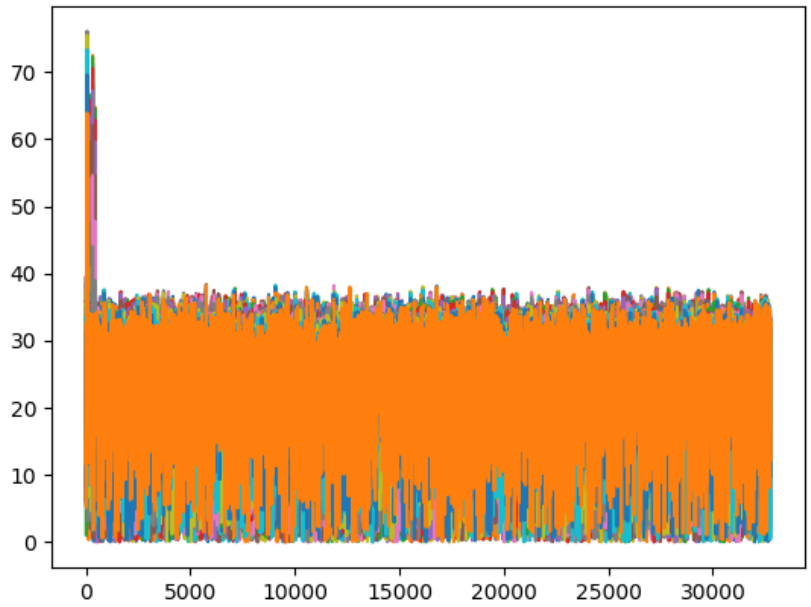

fig. 1 y-axis is the Amplitude of targets and noise, x-axis is the distance in simulator

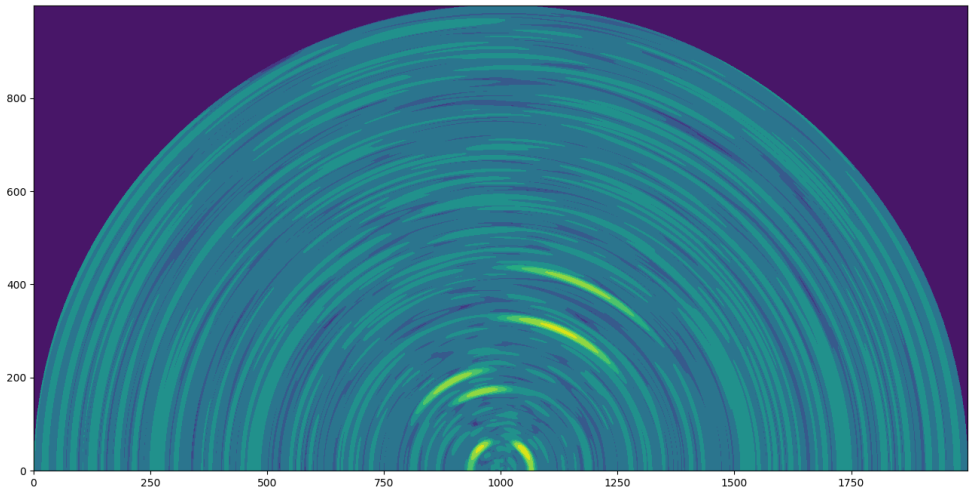

fig.2 contour of radar image, corresponing to algorithm step 6

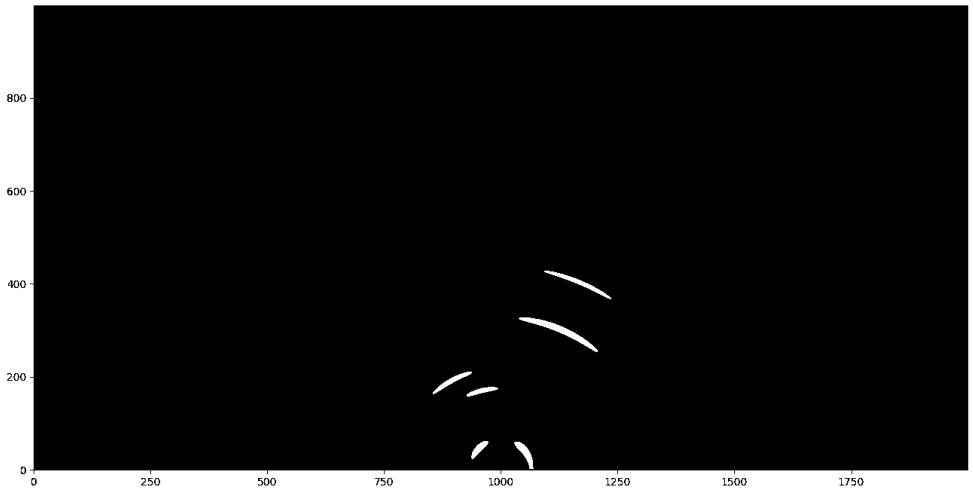

fig.3 binarized contour radar image named fig_eval, corresponding to algorithm step 7 and 8

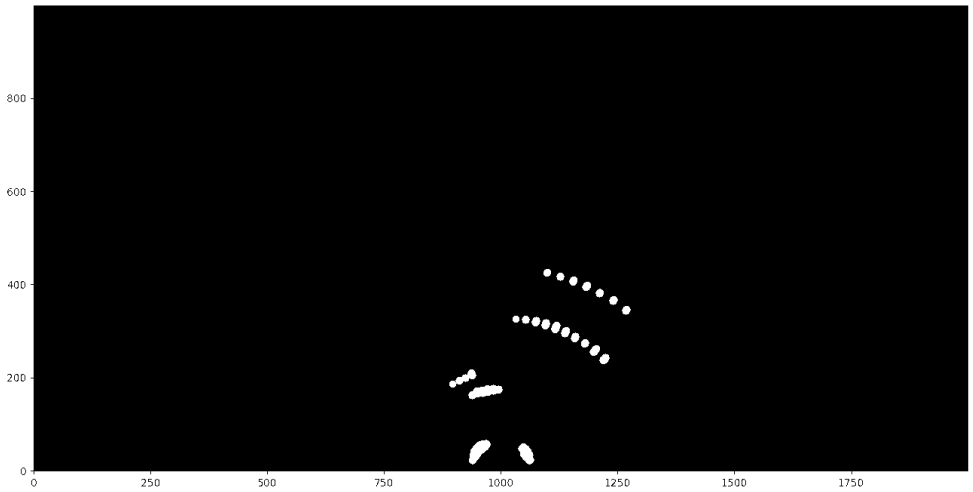

fig.4 binarized targets image with the maximum similarity to fig_eval, which is named fig_final, corresponding to algorithm steps 11 to 14

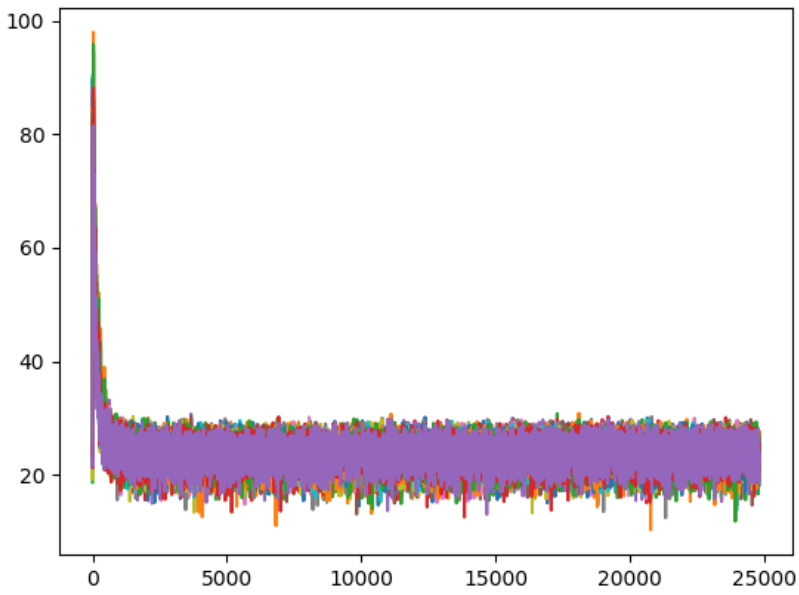

fig.5 Amplitude versus distance of real data

With the confidence from results above, we apply the same process on fourier transformed real data, which is shown in figures 5 to 8.

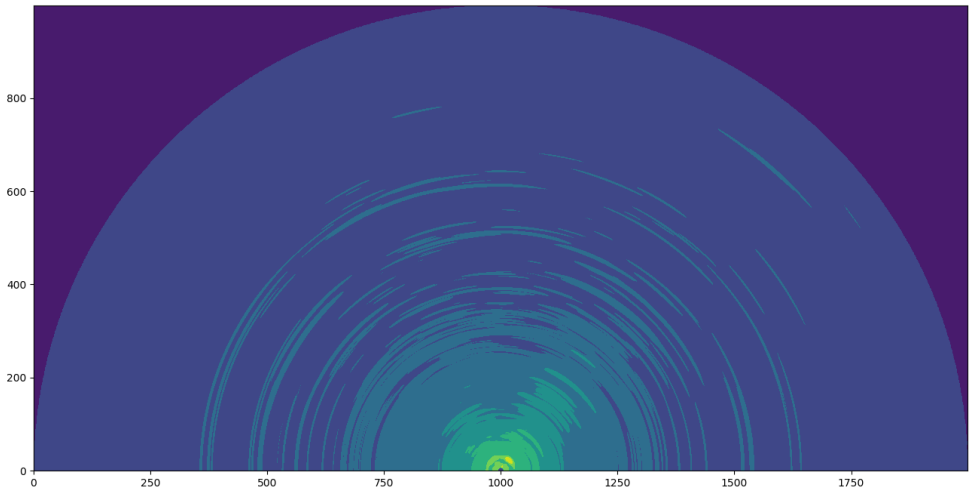

fig.6 contour of radar image

fig.7 binarized contour radar image named fig_eval

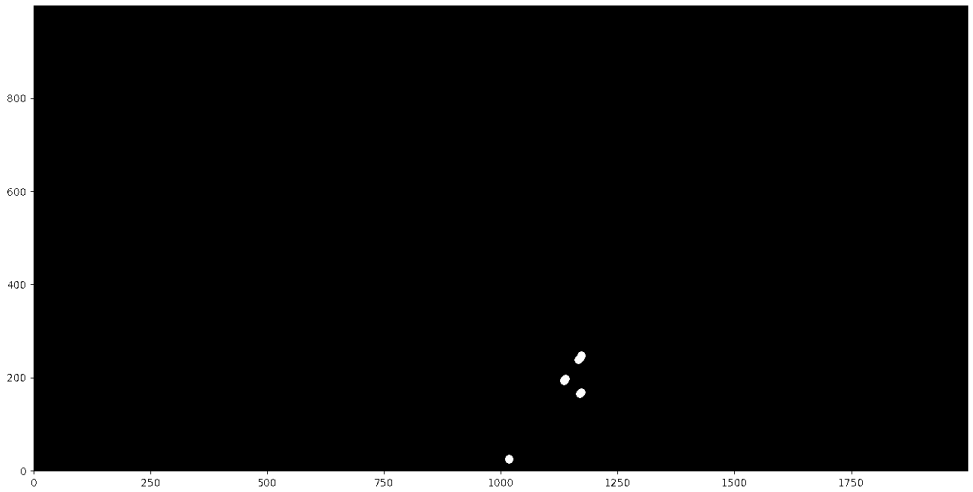

fig.8 binarized targets image with the maximum similarity named fig_final

Fig. 8 shows the target but meanwhile also 3 noise spots, which are not wanted. At this time we might add step 5 to see if there is any difference, shown in figures 9 to 12.

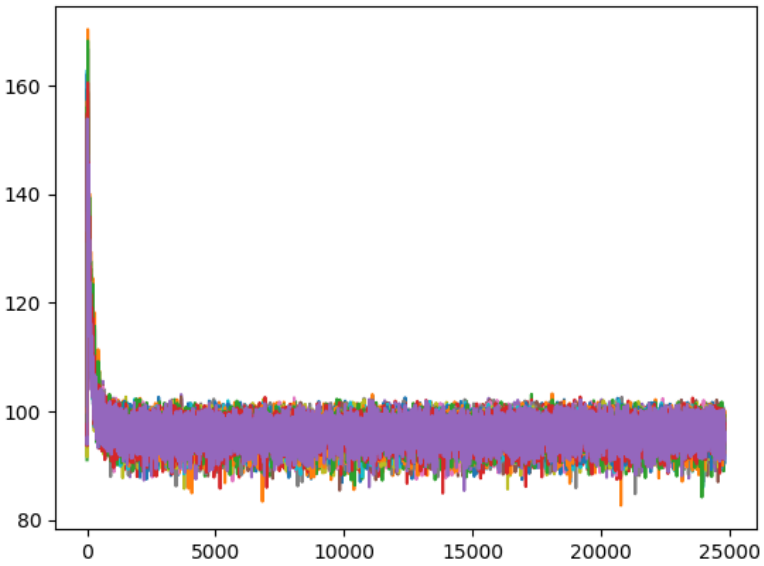

fig.9 Amplitude versus distance of real data with step 5

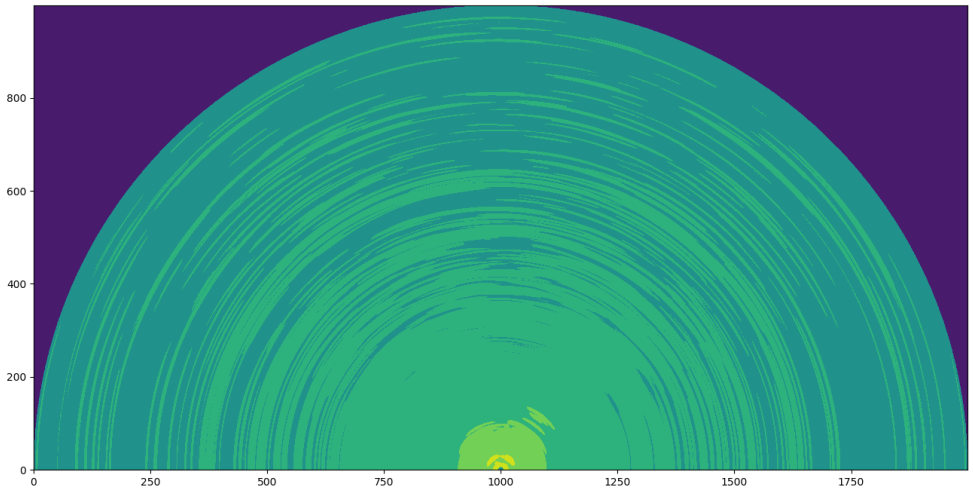

fig.10 contour of radar image with step 5

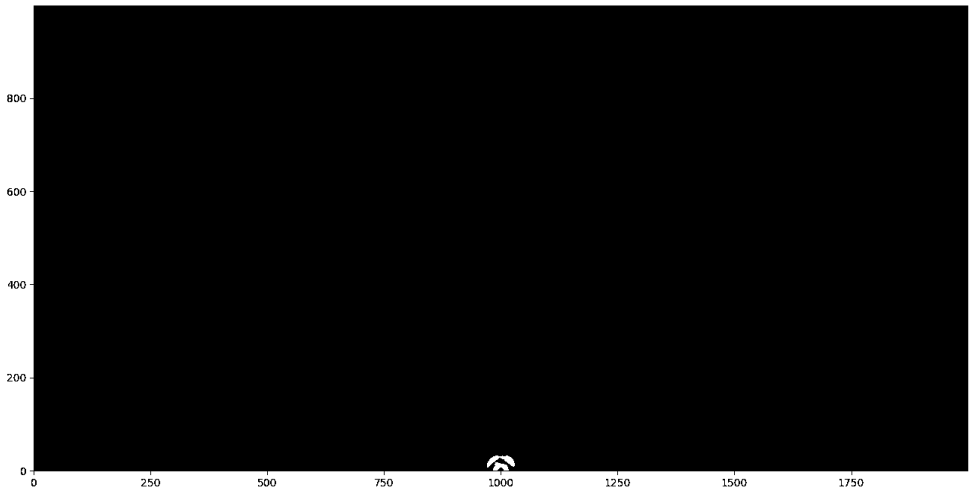

fig.11 binarized contour radar image named fig_eval with step 5

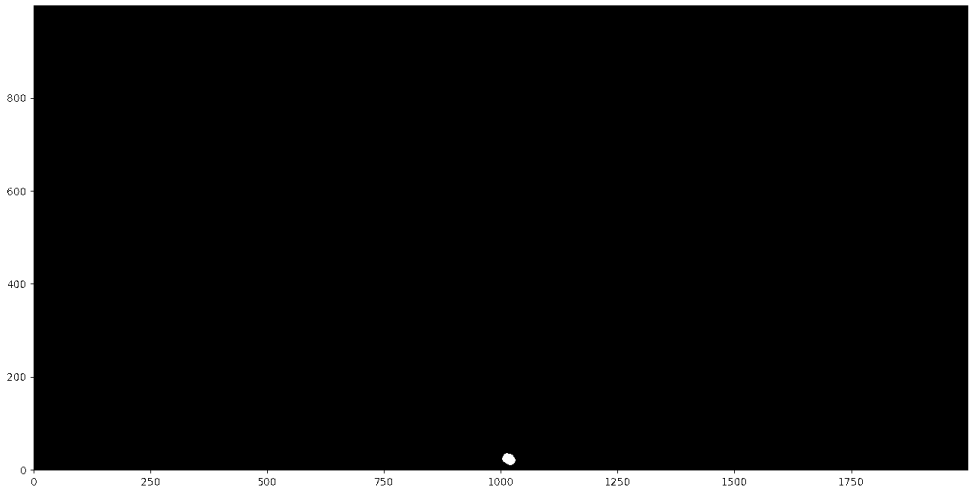

fig.12 binarized targets image with the maximum similarity named fig_final with step 5

From fig.12 we see the noise spots are disappeared. The reason for that is the algorithm step 5 can reduce the difference in amplitude between noise distributions. Because the threshold in OS CFAR is computed as $T = \alpha P$, where P is an estimate of background power level and α is the threshold multiplier. So we know that there is a proportional relationship between threshold and background noise. In some complicated environments, such as ocean, the noise distribution is a synthesis of many factors, thus has a big difference in amplitude between noise distributions. The threshold multiplier found are also consistent with certain noise points. Algorithm step 5 adds multiple of the background noise average (in this case the multiple factor is 3, which depends on the SNR) to the radar image, thus reduces ratio of amplitude differences between noise distributions.

To verify if the multiple factor depends on the SNR, the simulated data in fig.1 is used again. We see from fig.1, the SNR is about 2:1, from fig. 5, the SNR is about 3:1. Then we apply first multiple factor 2 to simulator and then 3. We see fig.16 with multiple factor 2 is better than fig.20 with multiple factor 3.

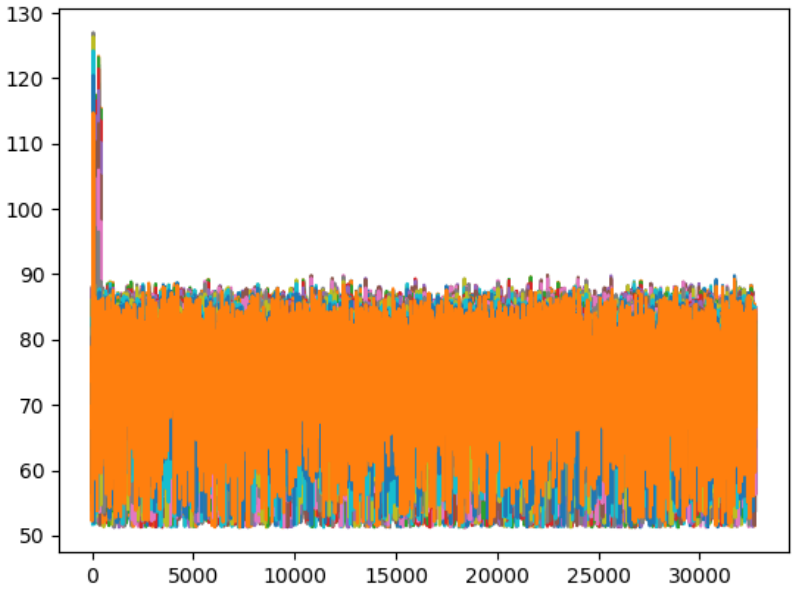

fig.13 Amplitude versus distance of simulator with step 5 and multiple factor of 2

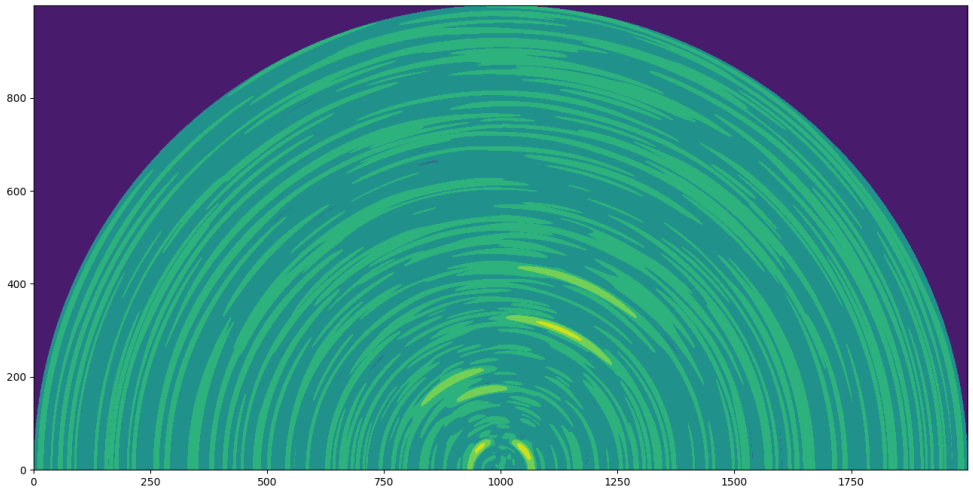

fig.14 contour of radar image of simulator with step 5 and multiple factor of 2

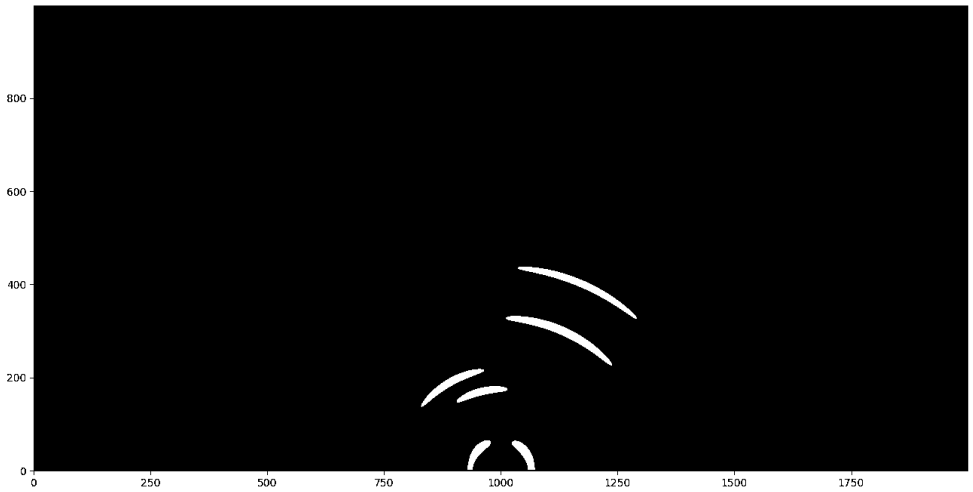

fig.15 binarized contour radar image named fig_eval of simulator with step 5 and multiple factor of 2

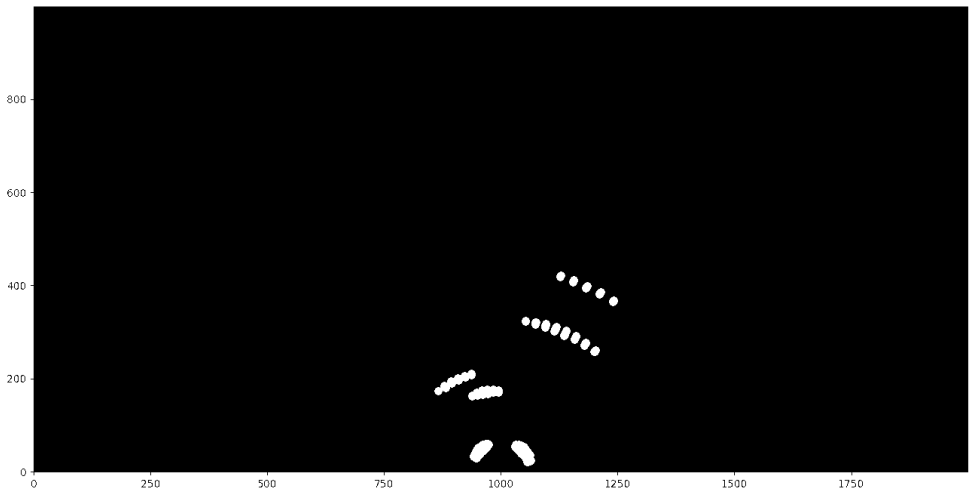

fig.16 binarized targets image with the maximum similarity named fig_final of simulator with step 5 and multiple factor of 2

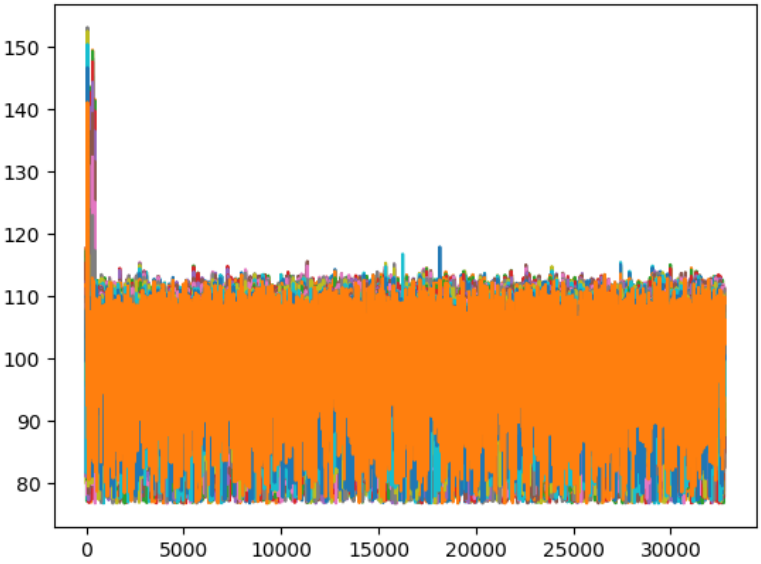

fig.17 Amplitude versus distance of of simulator with step 5 and multiple factor of 3

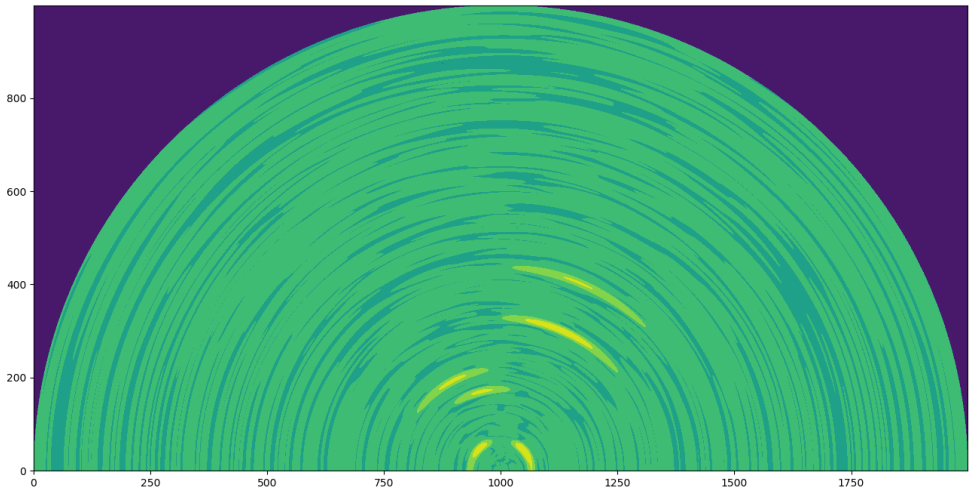

fig.18 contour of radar image of simulator with step 5 and multiple factor of 3

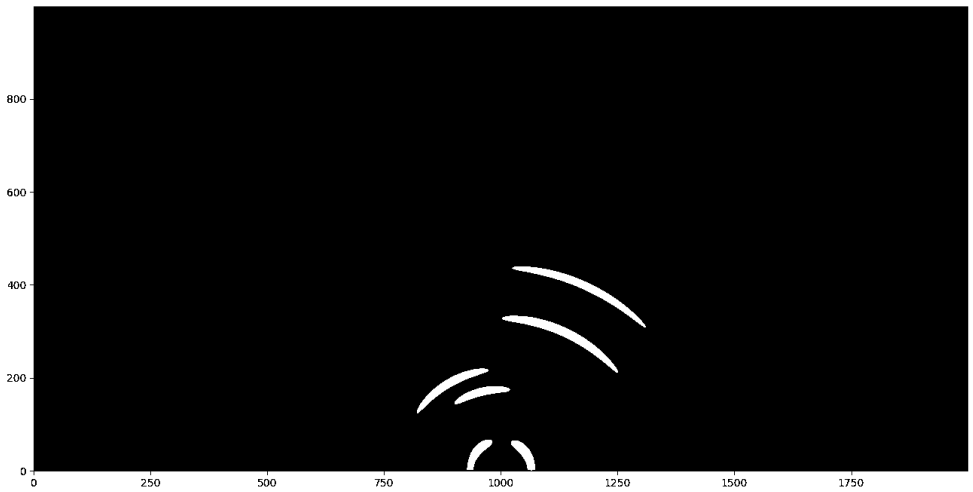

fig.19 binarized contour radar image named fig_eval of simulator with step 5 and multiple factor of 3

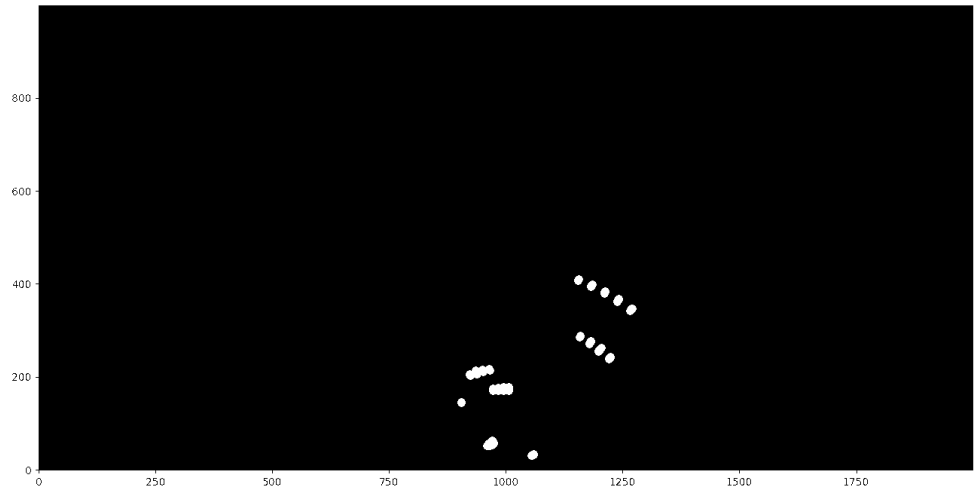

fig.20 binarized targets image with the maximum similarity named fig_final with step 5 and multiple factor of 3