This paper proposed a method to reshape particles using

workspace obstacles. This paper provides complete plots of

experimental data and complete formula derivations.

However, one of the reviewers mentioned that the authors

have not mentioned several Figures in the paragraph of the

text. The reviewer also questions several considerations in

the experiments, such as the usage of lights in different

watts, the friction of robots for the particle movement,

and the size of the kilobots. Another author questions the

contribution of this paper compared to the previously

published papers. In addition, the reviewer also asked the

authors to compare the experiment results to the analytical

predictions.

If the authors added several real-world situation that is

supported by the research, it would add an interesting

point in this paper. In addition, in order to add clarity,

the authors may provide several limitations of shapes that

can be constructed by the method. If the afore mentioned

reviews and suggestions are implemented in this paper, it

will add interests to the paper.

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Comments on Video Attachment:

The video of the experiments looks adequate. However, the

video really lacks explanations, making it very unclear.

REVIEWER 1:

Reviewer 11 of ICRA 2019 submission 153

Comments to the author

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This paper discussed analytical results using workspace

obstacles and global inputs to reshape a group of

particles. The proposed concepts are clearly explained with

the mathematical formulation of each concept. The provided

video also add the explanation of the experiments.

Please note the following points to improve the quality of

this work:

1. Consider providing some example applications of the

proposed method in real life.

We can have: a narrow corridor in a workspace where you want to deliver drugs inside the body.

2. All figures should be mentioned in the text part, Figure

1 hasn't been mentioned in the text part of the paper.

3. All figures should be mentioned in the text part, Figure

6 hasn't been mentioned in the text part of the paper.

4. All figures should be mentioned in the text part, Figure

9 hasn't been mentioned in the text part of the paper.

5. How many kilobots were used in the experiments in the

Figure 10?

6. What is the reason for using several lights with

different wattages?

I wanted to add but ran out of space: the different light wattages is because of the distances of the lights from the center of the table.

7. Consider using larger visualization of the conducted

experiments that depicted in Figure 11. The pictures are

too small to interpret

I wanted to make it bigger but ran out of space.

8. Please review the variables of Equation 8 and Equation

9, have all variables written correctly?

It does not look wrong to me, but I was not able to interpret our code to these equations, I don’t remember where it is.

9. Consider measuring the performance of each experiment

result, for example how well all kilobots follow the

expected movements.

Do we really care about this? We can say that kilobots does not follow the exact expected movements and have some error.

10. Does the friction between particles has an effect on

the expected particle movement?

Friction is not significant

11. Are all kilobots perfectly the same (uniform

assumption)? How to minimize this factor?

Sizewise they are almost the same. They definitely does not behave exactly the same. When we have a lot of them, we don’t care about individuals that much.

Comments on the Video Attachment

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The provided video could explain the proposed method

clearly

REVIEWER 2:

Reviewer 12 of ICRA 2019 submission 153

Comments to the author

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The paper presented how to reshape partile configuration by

using workspace obstacle and global inputs. The paper is

written very well with with detail analytical explanation,

but in related work, the authors do not state the main

contribution of the paper comparing to their previous

papers [9], [10], [21]. In [9], the authors have reported

about contrroling the particle swarm by using collision

with workspace. What are the differences to the current

paper?

At 9, we were controlling the variance of the particles using the workspace. In this paper we are controlling covariance and shape of the swarm is a key factor.

Chapter IV about shape control is already clear, but Fig 8

is too small so that the content is not readable. It can be

enhanced by explaining how to reach achievable mean and

variance by by manipulating workspace obstacle and global

inputs in detail. Furthermore, it can also consider the

effect of particle size related to the accuracy of

analytical results.

We are out of space to make these images bigger. (Although I really don’t think Fig. 8 is small.)

Furthermore, what a nice future work.

Chapter V about experiments is not very clear. It should

compare the experiment with the analytical results and

demontrate in the video, but the author only describe the

experiment results, without comparing to analytical

solution and discussing it. In experiment 1, the authors

used iron particle, which close to the analytical

assumption. In here, the author used varying angle attack

and tilt angle, which can compute analytically by using the

gravity force information. Therefore, the authors should be

able to compare the experiment with the analytical solution

in experiment 1.

What should we add to address this?

In the experiment 2 and 3, the authors used Kilobot which

have 3 cm size. The robot, of course, is not ideal particle

as in theoritical assumption. In here, the authors should

focus on the deviation of analytical prediction comparing

to the experiment results.

Yes kilobots are big. But we wanted to show they can behave like a particle. Right?

In general, the content of the paper is already proper for

International conference and the writing is also already

good. The authors still can improve the paper by comparing

the experiment to analytical prediction.

Comments on the Video Attachment

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The video content is about three experiments in the paper.

However, the video of experiment 1st and 3rd is not too

clear what is the parameters and results in those

experiments.