Hard to solve/ convince/ find a solution around the problem
Moderate difficulty
Simple Fix
Solutions or ideas to tackle the problem
General statements

Report:
This is an exciting UAS application - and this paper presents both this and some interesting results in solving some of the problems associated with making it a reality.

1.) The paper could be much stronger if it addressed more of the challenges and/or convinced the reader that the authors' have focused on critical challenges.

Review:
The authors present a system consisting of the combination of a UAS and a mobile/static device that can sense and measure a seismic event. The technology presented in this paper could be applied to a wide variety of the areas such as geoscience research, earthquake monitoring, and wildlife monitoring.

The concept is quite interesting, and the authors adequately describe the challenges we're facing and the importance of the technology that can quickly measure seismic events in an affordable manner. The both of the existing systems, cabled and wireless systems, have issues especially because they need a lot of manual laborers. The authors suggest that the use of a UAS to deploy and collect measuring devices should save both of time and cost.

2.) However, the contribution of this paper is not obvious.

3.) The capability of small UAVs to release an object in the air has been proven in many studies, and some of the studies have demonstrated the efficacy of the use of the combination of a UAS and a ground robot such as Nagatani, Keiji, et al. "Volcanic ash observation in active volcano areas using teleoperated mobile robots-Introduction to our robotic-volcano-observation project and field experiments." 2013 IEEE International Symposium on Safety, Security, and Rescue Robotics(SSRR). IEEE, 2013.

4.) I couldn't find any novelty on the presented methods. The only contribution I see is in terms of applying existing techniques to this specific problem (seismic surveying), but it is not sufficient. I suggest the improvement of the paper together with the additional experiments. Some of the reasons are explained in the following:

4a.) -The abstract indicates by mentioning an autonomous heterogeneous sensor deployment system, and the readers expect that the paper displays the efficacy of the autonomous system. That would include a UAV autonomously deploying and collecting a measuring device, or part of the mission. However, most of the experiments were done by manually piloted.

Sol: Instead of the current analysis we are going to perform an autonomous deployment of SeismicDarts to obtain data on exp.1. Penetration depth vs Drop Height and exp.2. Angle of Deviation vs Drop Height

4b.)-Does the suggested system work as good as the traditional system? Fig.8 compares the traditional system with the one deployed by the UAV. The latter results look a lot noisier. Is this acceptable? The experiments are poorly commented.

Sol: We are planning to correlate the two plots and also explain exactly what the features of primary interest are.

4c.) -The authors mention the FAA rules that limits the altitude of UAVs to 400 ft (122m), but the results of the drop test (Fig 4 and Fig 5) are ranged only 0mm to 80mm. If the penetration depths are valid only in this range, the use of the UAVs is not very effective.

Sol: This was a typo. The measurements were in cm. This plot could be edited to make better sense.

4d.) -The authors did not mention Fig. 6.

Sol: The Fig would be mentioned in the document with an apt description.

4e.) -The authors insist that the suggested system is suitable for much harder soils than tested in this paper because the dart in their experiment did not reach the theoretical terminal velocity and can be a lot faster if they drop the dart from a greater height. This analysis is oversimplified. The greater velocity at impact would cause several other issues.

4f.) -The simulation studies are poorly commented. I think the authors should explain more about the assumptions they made.
4g.) -Fig. 17 lacks in explanation. What are those dots and rods? What is that truck? Some of the UAVs are coming back to the truck, what is the strategy?

Sol: The above statements indicate the explanation on the experimental section was unclear. The section could be rewritten and a voice over during the videos might give a better understanding.

Conclusion:

5.) Although this paper is well written and deals with a good topic, scientific contributions are not clear to me.

6.) Relevance/Originality:

The application of UASs to seismic sensing as presented in this paper is relevant as recent patent applications (Seismic acquisition system-based unmanned airborne vehicle - https://www.google.com/patents/US20140078865) have included this precise application. However, since this application has already been presented in patent applications and is primarily a result of system integration (combining a UAS, release mechanism, and seismic sensor nodes), the focus of the paper seems less original, at least in the manner presented.

7.) Technical quality:

The results were presented well. I would like to see concrete connections to cost. It was mentioned that human labor results in high cost, time, and risks to humans. What is the expected value outcome of these seismic surveys? Is the cost of human labor worth the expected outcome, given the ability to be more precise? That comparison would be more relevant to deciding whether to continue this development in industry.

Sol: Cost analysis could be done to compare the systems. Data from a reliable source has to be obtained regarding traditional seismic surveying costs.

8.) Clarity of presentation/organization:

For the most part, the paper is well organized. However, the reason for the SeismicSpider was not presented until far into the SeismicSpider discussion. I believe this sensor is needed for (a) regions in which a UAS cannot penetrate such as forests or thin atmosphere environments (b) hard surfaces which the SeismicDart cannot penetrate. These reasons/relevance were not presented early in this discussions.

Sol: Rewriting the SeismicSpider section and explicitly stating its purpose and advantages is expected. Introducing the idea in the intial part of the paper is recommended and could be adapted.

Additional points:

9.) Heterogeneous surfaces were assumed for each test. If the surface is not sufficiently consistent, at what point is the accuracy of the drop not sufficient to ensure proper planting of a SeismicDart, requiring use of a SeismicSpider?

10.) How are surface composition tests conducted to determine proper sensor selection? Is this done with the UAS?

11.) What is the degradation of the sensor due to drop impact? Is there recalibration required?

12.) Accuracy of location seems to be a big factor, and RTK was mentioned as a way to make this possible. How would RTK be integrated into this system to deliver the required accuracy, or is this a separate focus area?

Summary:

The paper is relevant, and improves understanding of the use of UASs in this particular application. However, based on the manner presented, there are two main focus areas:

1) How well the autonomous sensors perform (which is stated as less novel, given that autonomous sensors are already in use)

2) Integration/deployment with a UAS. Since this is primarily a systems integration effort and was partially completed (the drop mechanism seems to be the main new part added; retrieval is still via manual pilot), this focus area seems to be only an incremental improvement.

The presentation of the paper is such that neither area is shown to be very novel. Again, I would stress that the applicability of this paper seems appropriate. However, the way it is presented needs improvement before it is one that I, as a person in the UAS industry, would read when deciding how to apply UASs in the area of seismic sensing.