Review of: "Ballistic Motion of Dust Particles in the "Collecting the Big Muley Lunar Rock" Sequence of the Apollo XVI Footage"

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Potential competing interests: No potential competing interests to declare.

Paper Review: "Ballistic Motion of Dust Particles in the 'Collecting the Big Muley' Lunar Rock' Sequence of the Apollo XVI Footage"

Summary of the Overall Paper:

Goals: The paper aims to develop a robust analytical method to trace and analyze the ballistic motion of dust particles kicked up during the Apollo 16 mission, specifically during the sequence where astronaut Charles Duke collects the Big Muley rock. The research seeks to compare the observed kinematics of dust particles with theoretical models and to verify the integrity of the original film footage used for analysis.

Methods: The study employs both 2D and 3D analysis techniques using footage from the Apollo 16 mission. It involves calculating the focal length used for shooting, identifying the launch dynamics of the dust particles, and setting up a perspective measurement system to track the motion of dust particles in space. The analysis also includes verifying the distortion and geometric aberrations in the images to ensure accuracy.

Results/Conclusions: The analysis tracked the motion of dust particles and compared them with theoretical models of ballistic motion.

Praise for the Paper:

Major Strengths:

Minor Strengths:

- **Historical Context:** By integrating historical data and footage from the Apollo 16 mission, the study provides a rich context that enhances the significance and relevance of the findings.
- Considers limitations of the analysis (e.g., single dust particle tracking).

Criticism:

Major Weaknesses:

- **Limited Scope of Application:** While the analysis is thorough for the specific sequence studied, the findings might not be easily generalizable to other scenarios or lunar missions without similar data.

Minor Weaknesses:

- **Presentation of Data:** The paper could benefit from clearer visual aids or simplified diagrams to help illustrate complex concepts and results, making the information more accessible to a broader audience.
- Relies on instrumental accuracy of Photoshop's Vanishing Point Filter.
- Does not account for potential variations in dust particle size or mass.
- Excludes initial frames where dust launch might be clearer.

Typos:

- The paper contains a few minor typographical errors, which should be corrected.

Specific Recommendations for Improvement:

1. *Section C.3.7.1:* The relationship between f, x, and y is unclear. The equation for f(x,y) does not explicitly involve x or y.
2. *Section C.3.8:* The claim that the model is "strongly validated" by the data seems incorrect. The model predicts the moon's gravitational acceleration to be twice its actual value, which is a significant discrepancy.
3. *Section C.3.9:* The authors use a model for E5 and E6 from reference 15, which includes an air drag term. These equations were developed for Earth, where air resistance is a factor, but the moon has no atmosphere. Therefore, these equations are not applicable to the lunar context.
4. *Spreadsheet Usage:* The methodology involving the "spreadsheet [Ann. C7]" is unclear, making it difficult to verify the claims made based on this data.
5. *Conclusion:* The paper fails to achieve its original goal due to the inability to validate results with known facts, such as the moon's gravitational acceleration. Additionally, it does not provide new insights into the grain size distribution of dust lofted from the moon's surface.
6. *Suggested Improvement:* Consider using a Monte Carlo simulation method with appropriate boundary conditions to simulate dust lofting and dispersion. This method should compare simulation data with actual frames captured in sync with time, providing a robust way to test the motion and size distribution of dust grains, aligning better with the authors' original goals.

Overall Recommendation:

The paper should be rejected. The methodology is flawed, predicting an incorrect gravitational acceleration for the moon. The revised methodology is also inappropriately applied in this context. The paper does not present new information based on frame tracking as described, and the authors' goals are not met.