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# Computational sedimentation modelling calibration: a tool to measure the settling velocity under different gravity conditions

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**Description of Supplementary Tables and Figures.**

**Table S1 shows the calculations performed to ensure that the image analysis procedure used to calculate the terminal velocity was correct. Supplementary Tables 2,3, and 4 summarize the data used to calculate the terminal velocity for hyper, Martian, and lunar gravity, respectively, using the least squares method. Supplementary Figures 1-16 show the vertical position of each sample in function of time, the Least Squares function and the R2 value for each set of data. Finally, terminal velocity, Reynolds number and drag coefficient as computed from the set of data obtained by applying the least square method to the range of data extracted by video analysis.**

**Table S1: Comparison between the terminal velocity calculated by eye counting frames, the number of frames (NOF) and the corresponding equation calculated by the least squares method. The distance traveled by a particle in the central part of the sedimentation chamber, $\Delta z = Z_f - Z_i$, is divided by the time, calculated as nof divided by the camera frequency (120 fps), $\Delta t$ = NOF/120. This yields the velocity $w = \Delta z/\Delta t$. As can be seen, there are no great fluctuations in the number of frames, and the absolute error between the terminal velocity values calculated by counting the number of frames and the least squares method is comprosed between 0.66 and 0.2 $cm \cdot s^{-1}$ for Chamber 1 (CH1), 1.05 and 0.04 $cm \cdot s^{-1}$ for Chamber**

**2 (CH2), and 0.39 and 0.08 2 cm·s$^{-1}$ for Chamber 4 (CH4). The comparison shows that the automated procedure provides reliable results and can be used to calculate terminal velocities at different gravities.**

| **CH1** | **$Z_i$ (cm)** | **$Z_f$ (cm)** | **Δz (cm)** | **NOF** | **w (cm·s$^{-1}$)** | **Equation from linear regression** |
|---|---|---|---|---|---|---|
| 1/10 | 10.9696 | 13.16763 | 2.19803 | 8 | 32.970 | z(t) = 33.279t - 3.7672 |
| 2/10 | 10.80526 | 12.90058 | 2.09532 | 8 | 31.429 | z(t) = 30.937t - 4.9022 |
| 3/10 | 10.86689 | 12.94166 | 2.07477 | 8 | 31.126 | z(t) = 31.142t - 6.5341 |
| 4/10 | 10.80526 | 12.81841 | 2.01315 | 7 | 34.511 | z(t) = 34.247t - 8.8405 |
| 5/10 | 10.88743 | 13.00329 | 2.11586 | 7 | 36.272 | z(t) = 36.477t - 11.337 |
| 6/10 | 10.84634 | 13.06491 | 2.21857 | 8 | 33.278 | z(t) = 33.566t - 9.8829 |
| 7/10 | 10.88743 | 13.02383 | 2.1364 | 7 | 36.624 | z(t) = 36.771t - 12.178 |
| 8/10 | 11.01068 | 13.16763 | 2.15694 | 8 | 32.354 | z(t) = 32.95t - 9.0754 |
| 9/10 | 10.9696 | 13.106 | 2.1364 | 8 | 32.046 | z(t) = 31.389t - 9.6293 |
| 10/10 | 10.80526 | 12.92112 | 2.11586 | 9 | 28.211 | z(t) = 28.819x - 9.594 |
| **CH2** | **$Z_i$ (cm)** | **$Z_f$ (cm)** | **Δz (cm)** | **NOF** | **w (cm·s$^{-1}$)** | **Equation from linear regression** |
| 1/10 | 10.90116 | 13.12292 | 2.22176 | 9 | 29.623 | z(t) = 29.795t - 3.2411 |
| 2/10 | 10.8804 | 12.97757 | 2.09718 | 8 | 31.456 | z(t) = 32.184t - 4.909 |
| 3/10 | 10.81811 | 12.99834 | 2.18023 | 8 | 32.703 | z(t) = 32.517t - 6.5375 |
| 4/10 | 10.81811 | 12.91528 | 2.09718 | 9 | 27.962 | z(t) = 27.922t - 4.0555 |
| 5/10 | 10.8804 | 12.97757 | 2.09718 | 8 | 31.456 | z(t) = 30.399t - 6.8503 |
| **CH4** | **$Z_i$ (cm)** | **$Z_f$ (cm)** | **Δz (cm)** | **NOF** | **w (cm s$^{-1}$)** | **Equation from linear regression** |
| 1/10 | 10.93109 | 13.04348 | 2.112387 | 8 | 31.685 | z(t) = 31.296t - 2.0834 |
| 2/10 | 11.05177 | 13.14708 | 2.09532 | 8 | 31.429 | z(t) = 31.306t - 1.739 |
| 3/10 | 10.88743 | 13.08546 | 2.19803 | 9 | 29.307 | z(t) = 28.909t - 4.2706 |
| 4/10 | 10.92851 | 13.02383 | 2.09532 | 8 | 31.429 | z(t) = 31.512t - 4.8211 |
| 5/10 | 10.88743 | 12.90058 | 2.01315 | 8 | 30.197 | z(t) = 30.033t - 6.3897 |

**Table S2: Summary data of the samples in hypergravity. Column 2 and 3 show the range of time and distance, respectively, from which the terminal velocity is calculated by the least squares method. For completeness, the last column shows the range of gravity values recorded by the gravity logger, with a frequency of 1/10 Hz. For each sample, a figure of the position of a particle is shown as a function of time below. Each figure also shows the function obtained by applying the least squares method to the data set and the value of R2. As can be seen, the value of R2 is very close to 1, indicating that the linear regression fit very well with the measured data, and that the particles has actuatty reached a constant terminal velocity.**

| Hyper gravity | Range of time (s) | Range of distance (cm) | Range of gravity (m $s^{-2}$) |
|---|---|---|---|
| Sample 1 | 0.1 – 0.7083 | 0.206 – 24.733 | 15.865 – 16.765 |
| Sample 1/5 | 0.083 – 0.675 | 0.186 – 24.628 | 16.814 – 17.471 |
| Sample 2/5 | 0.233 – 0.783 | 0.165 –24.793 | 16.814 – 17.716 |
| Sample 3/5 | 0.241 – 0.775 | 0.165 – 24.627 | 16.814 – 17.716 |
| Sample 4/5 | 0.250-0.775 | 0.0413– 24.627 | 18.586 – 19.593 |
| Sample 5/5 | 0.4 – 0.958 | 0.124 – 24.793 | 17.110 – 17.691 |

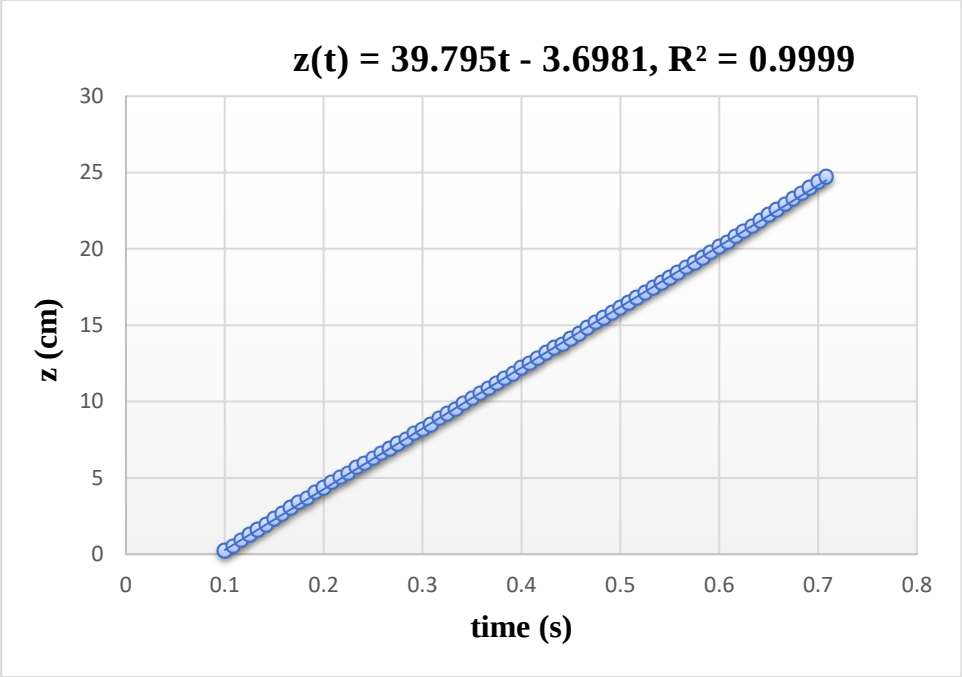


**Figure S1: Sample Hyper 1**

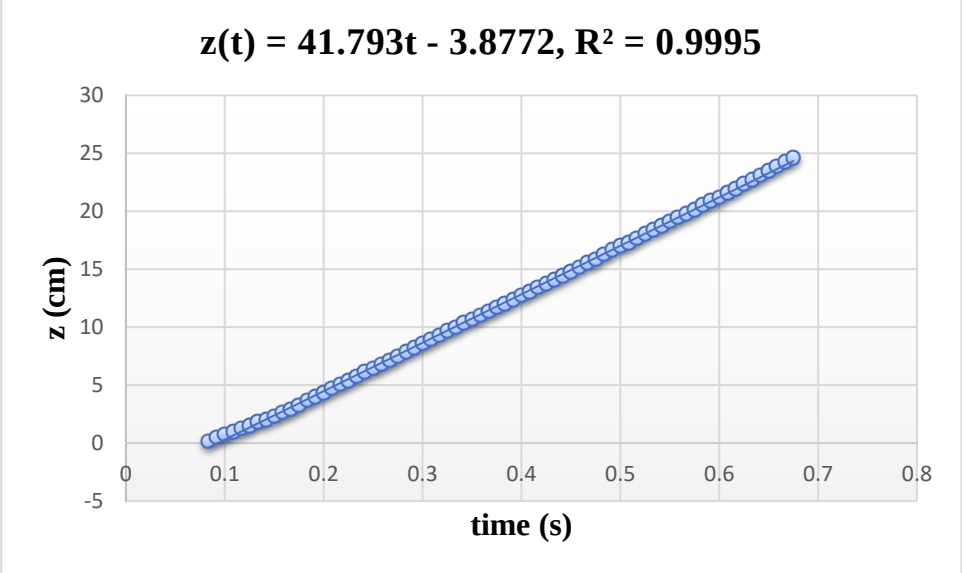


**Figure S2: Sample Hyper 1/5**

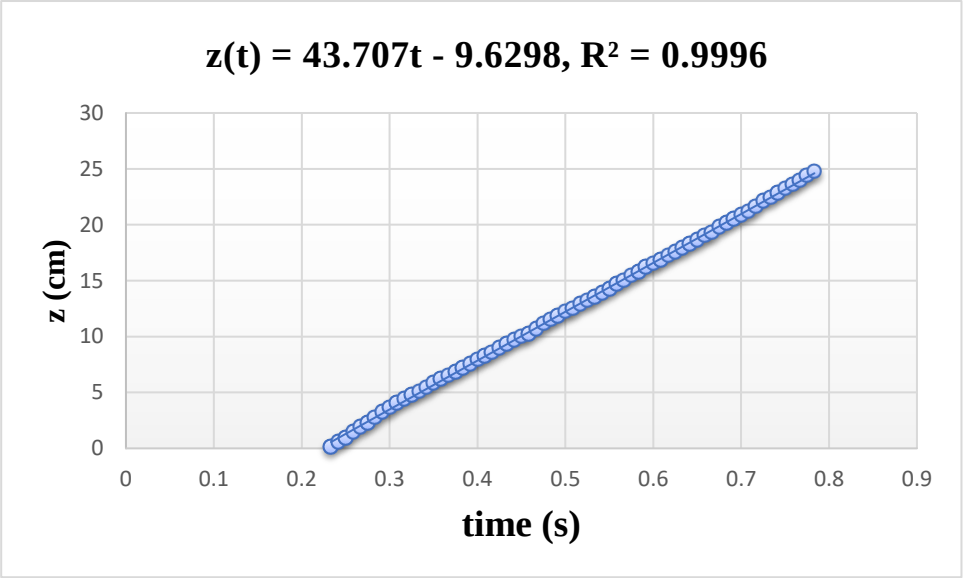


**Figure S3: Sample Hyper 2/5**

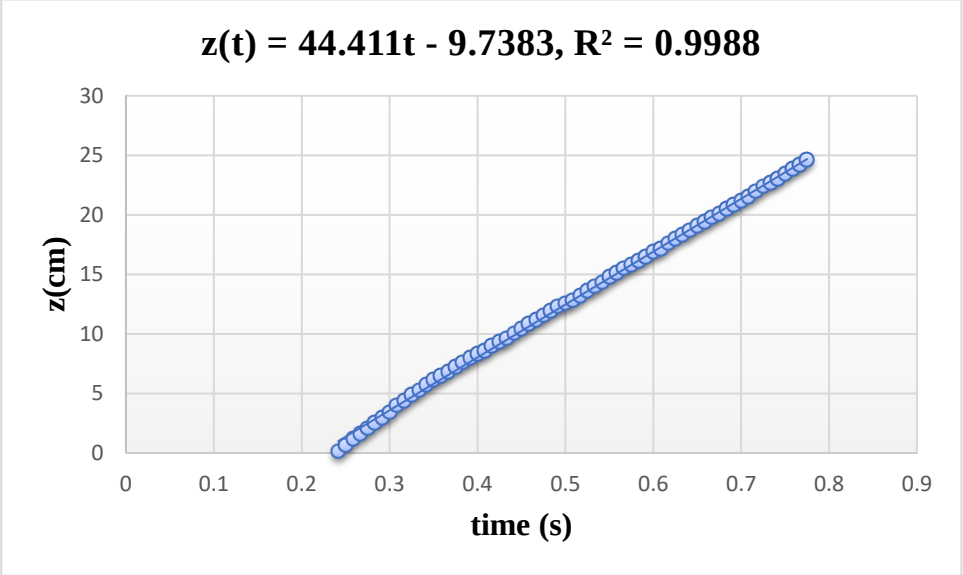


**Figure S4: Sample Hyper 3/5**

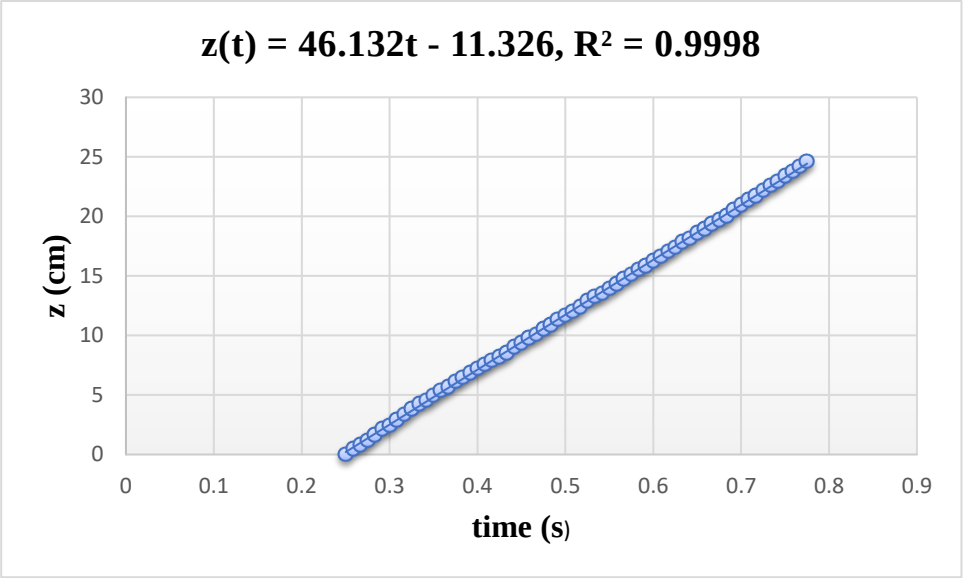


**Figure S5: Sample Hyper 4/5**

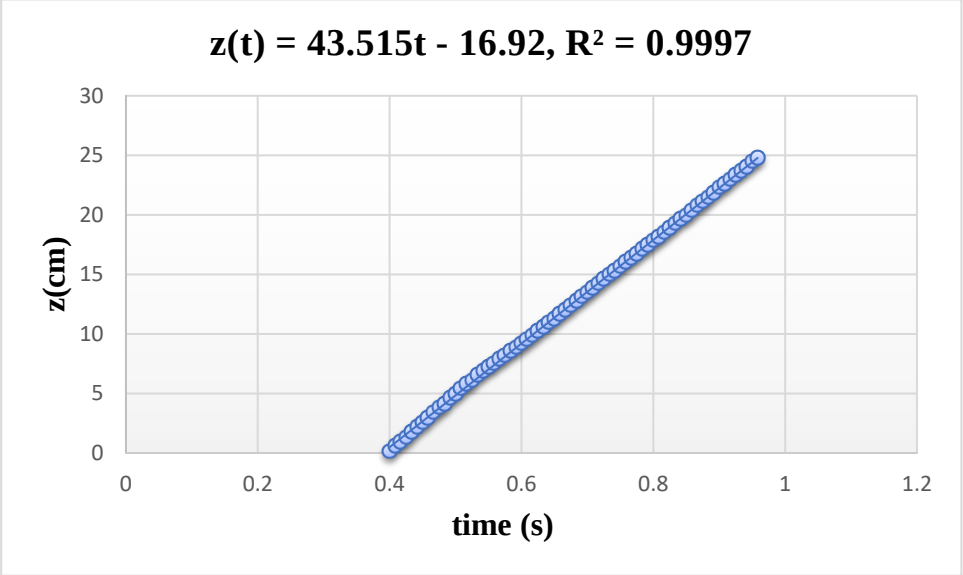


**Figure S6: Sample Hyper 5/5**

**Table S3: Summary data of the samples in Martian gravity (see Supplementary Table 2).**

| Martian gravity | Range of time (s) | Range of distance (cm) | Range of gravity (m $s^{-2}$) |
|---|---|---|---|
| Sample 1 | 0.241 - 1.666 | 0.102 - 24.917 | 3.476 - 4.411 |
| Sample 1/5 | 0.216 - 1.575 | 0.103 - 24.814 | 4.085 – 3.780 |
| Sample 2/5 | 0.241 - 1.683 | 0.041 - 24.813 | 4.085 - 3.780 |
| Sample 3/5 | 0.258 - 1.566 | 0.206 - 24.834 | 4.085 – 3.780 |
| Sample 4/5 | 0.258 - 1.616 | 0.124 - 24.896 | 0.416 - 0.385 |
| Sample 5/5 | 0.216 - 1.55 | 0.041 - 24.855 | 3.792 - 4.378 |

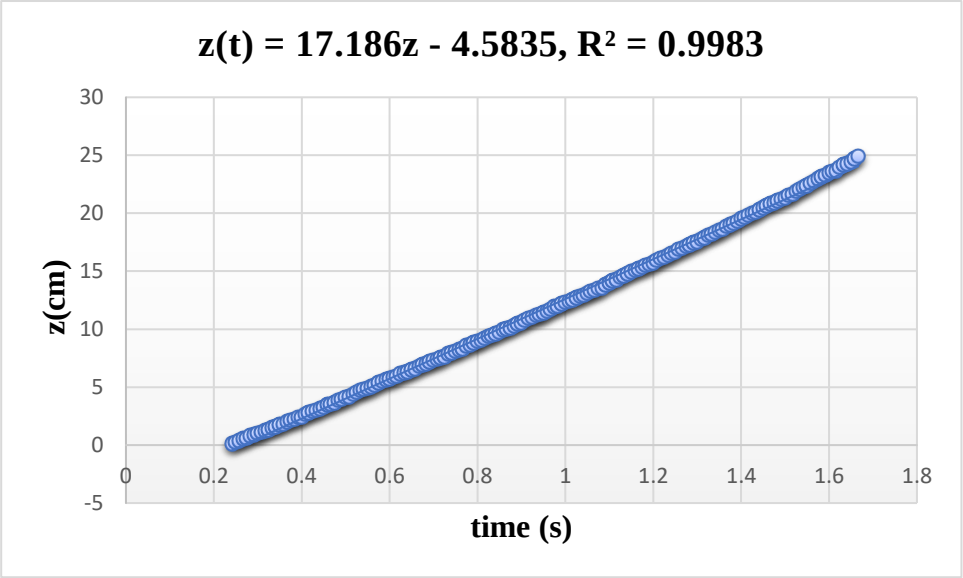


**Figure S7: Sample Mars 1**

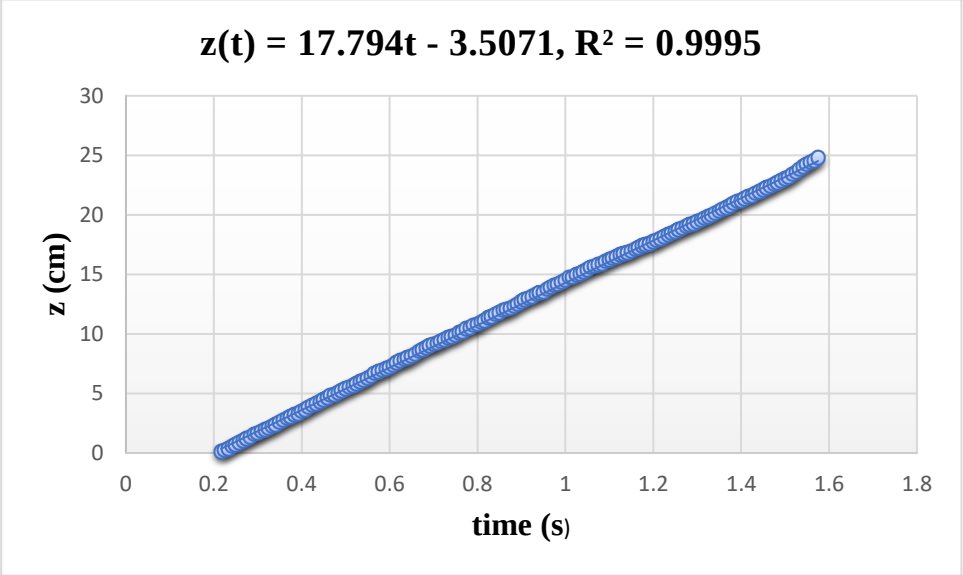


**Figure S8: Sample Mars 1/5**

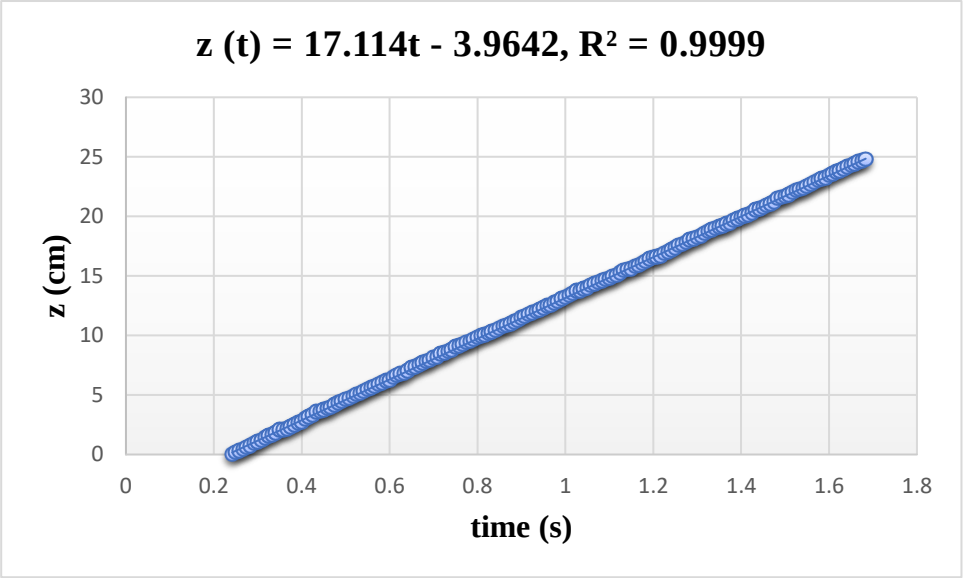


**Figure S9: Sample Mars 2/5**

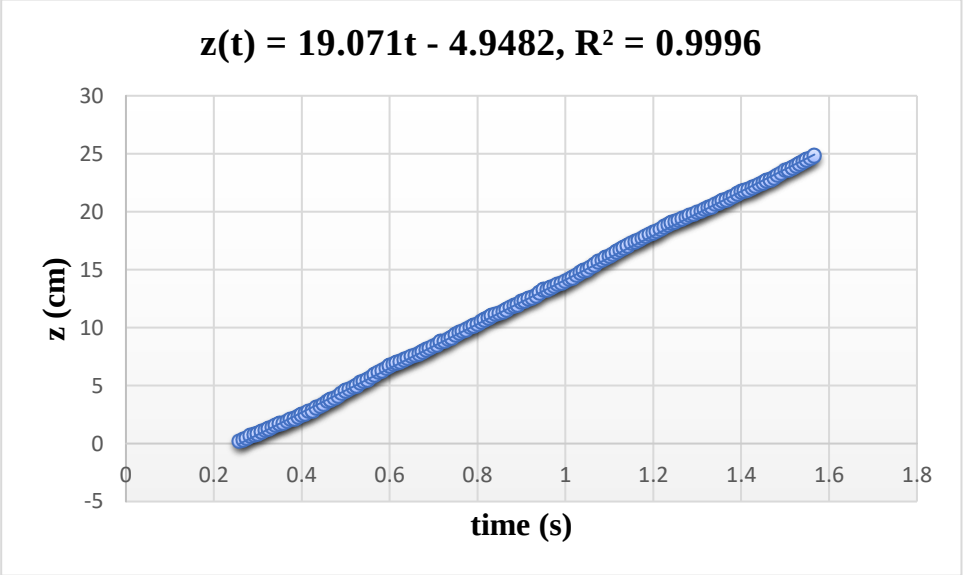


**Figure S10: Sample Mars 3/5**

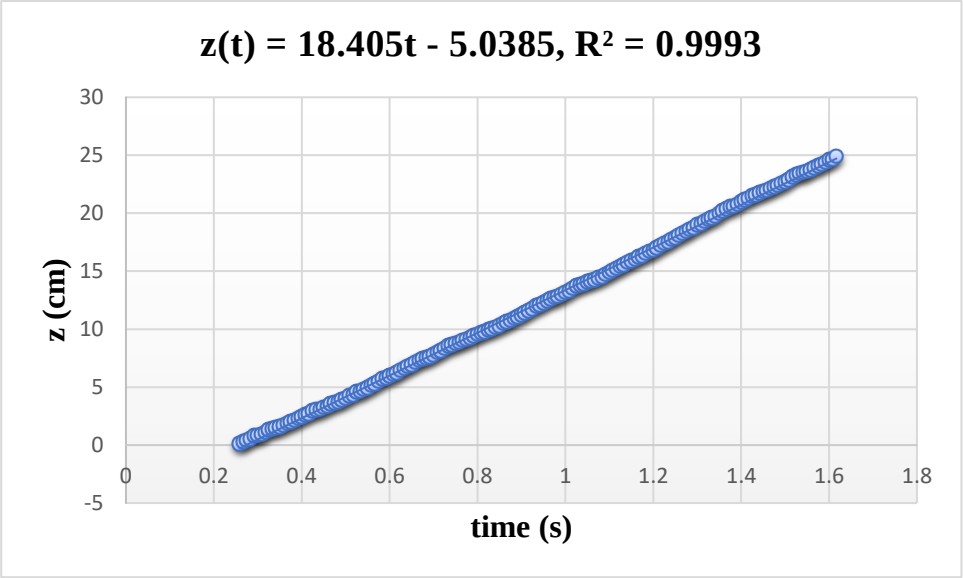


**Figure S11: Sample Mars 4/5**

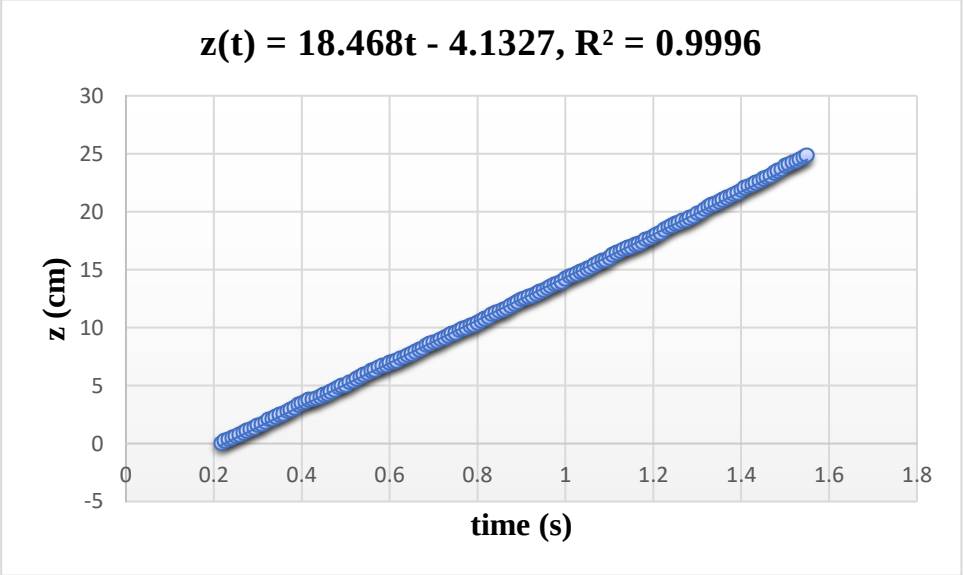


**Figure S12: Sample Mars 5/5**

**Table S4: Summary data of the samples in Martian gravity (see Supplementary Table 2 and 3)**

| Lunar gravity | Range of time (s) | Range of distance (cm) | Range of gravity (m $s^{-2}$) |
|---|---|---|---|
| Sample 1 | 0.4 - 2.758 | 0.165 - 24.813 | 2.040 - 2.017 |
| Sample 1/3 | 0.308 - 2.775 | 0.164 - 24.897 | 1.159 - 1.992 |
| Sample 2/3 | 0.308 - 2.825 | 0.041 - 24.979 | 0.118 - 0.2 |
| Sample 3/3 | 0.366 - 2.716 | 0.082 - 24.917 | 2.063 - 1.991 |

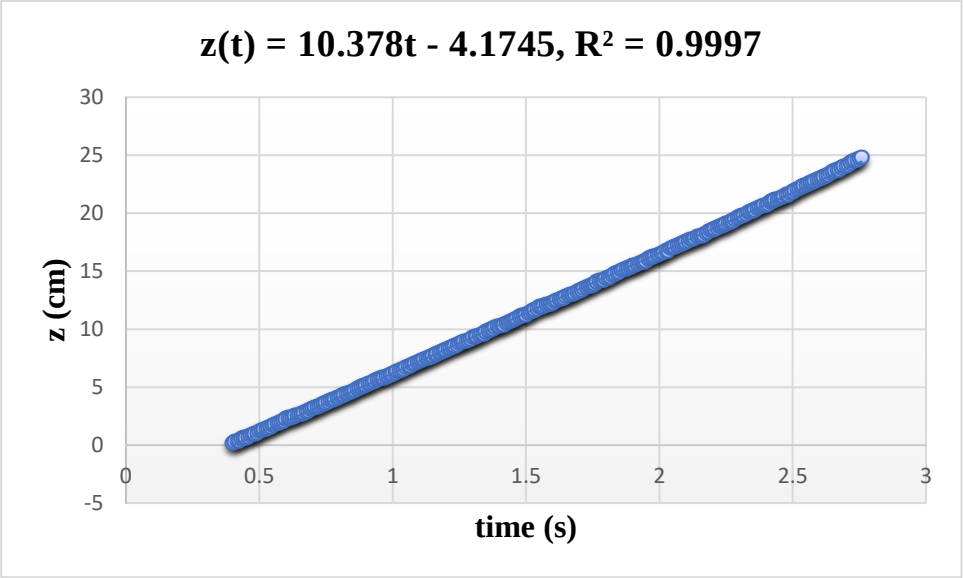


**Figure S13: Sample Moon 1**

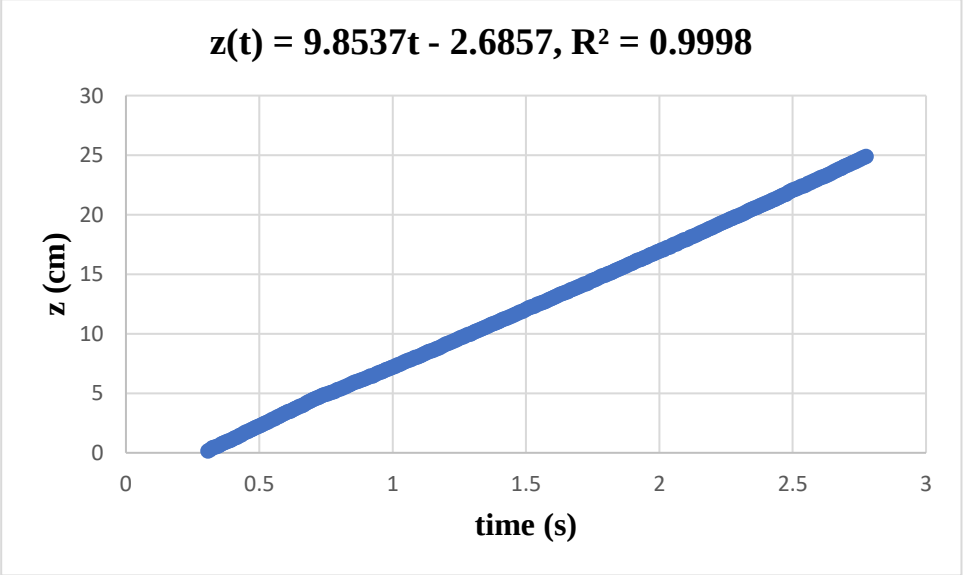


**Figure S14: Sample Moon 1/3**

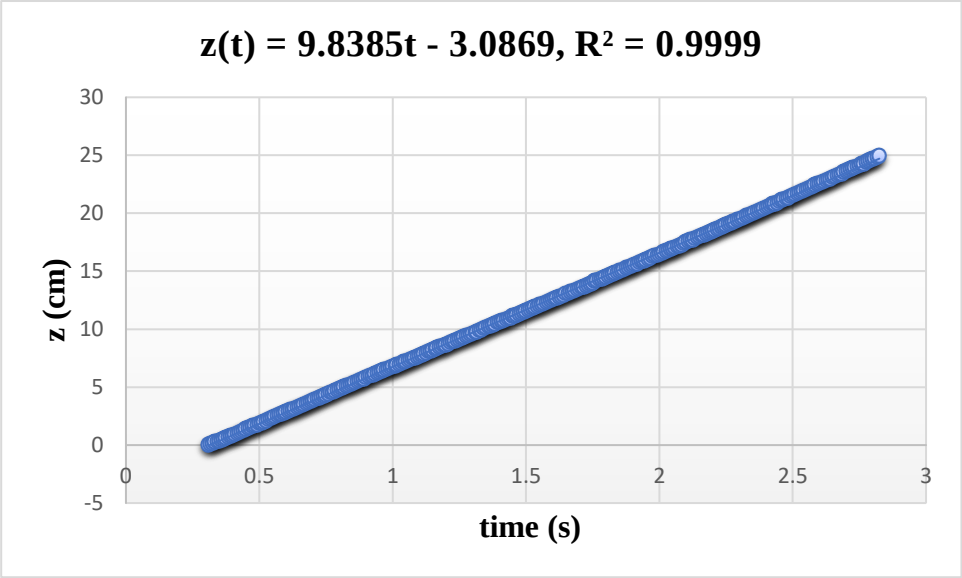


**Figure S15: Sample Moon 2/3**

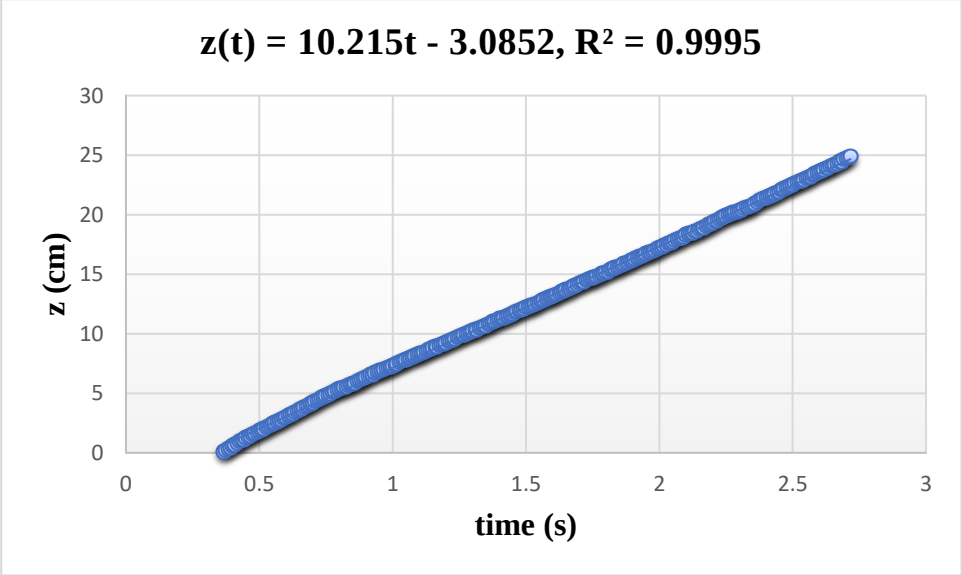


**Figure S16: Sample Moon 3/3**

**Table S5: Terminal velocity, Reynolds number and Drag coefficient for each sample and each acceleration gravity. The terminal velocity are calculated using the Least Squares method applied to the set of data reported in Supplementary Tables 2-4. The value of gravity is extracted by the gravity logger.**

| Sample (Hyper) | Gravity (m $s^{-2}$) | w (cm $s^{-1}$) | Re | $C_d$ |
|---|---|---|---|---|
| Sample 1 | 16.2 | 39.8 | 764.3 | 0.38 |
| Sample 1/5 | 17.0 | 41.8 | 802.7 | 0.36 |
| Sample 2/5 | 17.2 | 43.7 | 839.2 | 0.33 |
| Sample 3/5 | 17.2 | 44.4 | 852.6 | 0.32 |
| Sample 4/5 | 17.2 | 46.1 | 885.3 | 0.30 |
| Sample 5/5 | 17.5 | 43.5 | 835.3 | 0.34 |
| Mean samples 1-5/5 | 17.2 | 43.9 | 843 | 0.34 |
| Standard deviation 1-5/5 | 0.16 | 1.6 | 29.9 | 0.02 |

| **Sample (Mars)** | **Gravity (m $s^{-2}$)** | **w (cm $s^{-1}$)** | **Re** | **$C_d$** |
|---|---|---|---|---|
| Sample 1 | 3.80 | 17.2 | 330.3 | 0.48 |
| Sample 1/5 | 3.95 | 17.8 | 341.8 | 0.46 |
| Sample 2/5 | 3.93 | 17.1 | 328.4 | 0.50 |
| Sample 3/5 | 3.94 | 19.1 | 366.8 | 0.40 |
| Sample 4/5 | 3.94 | 18.4 | 353.3 | 0.43 |
| Sample 5/5 | 4.02 | 18.5 | 355.3 | 0.44 |
| Mean samples 1-5/5 | 3.96 | 18.2 | 349.1 | 0.45 |
| Standard deviation 1-5/5 | 0.04 | 0.8 | 14.6 | 0.04 |
| **Sample (Moon)** | **Gravity (m $s^{-2}$)** | **w (cm $s^{-1}$)** | **Re** | **$C_d$** |
| Sample 1 | 1.91 | 10.4 | 199.7 | 0.66 |
| Sample 1/3 | 1.91 | 9.9 | 190.1 | 0.73 |
| Sample 2/3 | 1.91 | 9.8 | 188.2 | 0.73 |
| Sample 3/3 | 1.91 | 10.2 | 195.7 | 0.68 |
| Mean samples 1-3/3 | 1.91 | 9.97 | 191.3 | 0.71 |
| Standard deviation 1-3/3 | 0 | 0.21 | 3.9 | 0.03 |