SOME RELATIVELY HIGH INCONSISTENCIES IN THE OFFICIAL APOLLO MISSION DATA AND AN ALTERNATIVE SCENARIO CONSISTENT WITH RESPECT TO SOME MANNED LUNAR LANDING MISSIONS AND WITH RESPECT TO THE HISTORICAL CONTEXT.

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Abstract. The aim of the following article is not to doubt about some successful American manned lunar landings since the 12 Saturn V rockets involved in the official Apollo missions have more than enough Delta-v to achieve that goal whatever the small precise mission details. The aim of the following article is to propose some alternative scenario to the official Apollo missions data since the cold war, the deterrence strategy, the secret military, the propaganda war, the ideological war, the pressure and the stress from a space race competition could affect greatly the released official Apollo missions data. For example, only decades later we knew Yuri Gagarin have not landed inside his atmospheric re-entry capsule but with some individual parachute. To achieve that aim, we simulate or calculate the most we can and look what was the easier practical solutions at that time and check the consistency of the official Apollo missions data.

The aim of the following article is not to doubt about some successful American manned lunar landings since the 12 Saturn V rockets involved in the official Apollo missions have more than enough Delta-v to achieve that goal whatever the small precise mission details. The aim of the following article is to propose some alternative scenario to the official Apollo missions data since the cold war, the deterrence strategy, the secret military, the propaganda war, the ideological war, the pressure and the stress from a space race competition could affect greatly the released official Apollo missions data. For example, only decades later we knew Yuri Gagarin have not landed inside his atmospheric re-entry capsule but with some individual parachute. To achieve that aim, we simulate or calculate the most we can and look what was the easier practical solutions at that time and check the consistency of the official Apollo missions data.

Some relatively high inconsistencies of the Official Apollo Mission Data are found in the maximum G deceleration of the Apollo 15 atmospheric re-entry, in the maximum G deceleration of the Apollo 4 atmospheric re-entry, in the Apollo 4 atmospheric re-entry range and in the heat shield mass thickness of the Apollo missions.

From the well know values of the Drag coefficient C_D^∞ (at infinite Mach), the Lift Coefficient $C_L^\infty(t)$ (at infinite Mach and depending on the Yaw angle except for the Vostok-1 atmospheric entry), the total initial mass of the re-entry module M_{mod}, the initial flight path angle Θ and the initial speed V_0, we can simulate easily the

Date: October 8, 2021.

atmospheric re-entry trajectory with a Mathematica program. With the Silica well know values of the density ρ_{HS}, of the heat transmission κ, of the fusion temperature T_{Fusion}, of the latent heat of fusion l_{Fusion} and with the well know values of the heat capacity of aluminum C_p^{IN}, of the initial mass of the heat shield $m_{HS}(0)$ and the surface of the Heat Shield S_{HS}, we can simulate easily with a Mathematica program the time dependent temperature of the outside surface of the head shield T_{OS} and the time dependent temperature of the inside re-entry module T_{IN} and the time dependent heat shield mass thickness $1 \times m_{HS}/S$.

(1)

$$\ddot{r} - r\,\dot{\theta}^2 = -\frac{GM_{\oplus}}{r^2} + \alpha\,\rho\,(r)\sqrt{\dot{r}^2 + r^2\left(\dot{\theta} - \Omega\right)^2}\left(-C_D^{\infty}\,\dot{r} + C_L^{\infty}(t) r\left(\dot{\theta} - \Omega\right)\right)$$

(2)
$$r\,\ddot{\theta} + 2\dot{r}\,\dot{\theta} = \alpha\,\rho\,(r)\sqrt{\dot{r}^2 + r^2\left(\dot{\theta} - \Omega\right)^2}\left(-C_L^{\infty}(t)\dot{r} - C_D^{\infty}\,r\left(\dot{\theta} - \Omega\right)\right)$$

(3)
$$\alpha = (1/2)\,(S_{HS}/M_{mod})\,,\ \Omega = \Omega_{\oplus}\ Cos\,(\theta_{lat})$$

(4)
$$r_0 = R_{\oplus} + 400\ 000 \times 0.3048$$

(5)
$$\theta_0 = 0$$

(6)
$$\dot{r}_0 = -V_0\ Sin\,(\Theta)$$

(7)
$$r_0\dot{\theta}_0 = V_0\ Cos\,(\Theta)$$

(8)
$$a\sqrt{\rho\,(r)}\ \sqrt{\dot{r}^2 + r^2\left(\dot{\theta} - \Omega\right)^2}^{\,3} =$$
$$1 \times \sigma T_{OS}^4 + 1 \times \kappa\,(T_{OS} - T_{IN})\,/\,(m_{HS}/\rho_{HS}/S_{HS})$$

(9)
$$C_p^{IN}\,(M_{mod} - m_{HS}(0))\,\dot{T}_{IN}/S_{HS} =$$
$$-2 \times \sigma T_{IN}^4 + 1 \times \kappa\,(Min\,(T_{Fusion}, T_{OS}) - T_{IN})\,/\,(m_{HS}/\rho_{HS}/S_{HS})$$

(10)
$$-\dot{m}_{HS}\ l_{Fusion}/S_{HS} =$$
$$Ramp\left(1 \times \sigma\left(T_{OS}^4 - T_{Fusion}^4\right) + 1 \times \kappa\,(T_{OS} - T_{Fusion})\,/\,(m_{HS}/\rho_{HS}/S_{HS})\right)$$

(11)
$$a = 1.83 \times 10^{-4}\,(\pi/S_{HS})^{1/4}\,,\ \Omega = \Omega_{\oplus}\ Cos\,(\theta_{lat})$$

(12)
$$T_{IN}(0) = 10 = 273.15K$$

(13)
$$m_{HS}(0) = m_{Initial\ Heat\ Shield}$$

Remark: For the Vostok-1 atmospheric entry module, the factor $\times 1$ should be replaced by $\times 4$ and the factor $\times 2$ should be replaced by $\times 0$.

A relatively high inconsistency of the official maximal deceleration of Apollo 15 during the atmospheric re-entry was found. It is only 0.4% lower than the maximal deceleration from the Mathematica simulation but it should be about $15 - 40\%$

higher in practice from the atmospheric turbulences, the vibrations, the atmospheric inhomogeneities, etc...

The same inconsistency at a lower level if also found with the official maximal deceleration of Apollo 13 during the atmospheric re-entry. It is only 9.6% higher than the maximal deceleration from the Mathematica simulation but it should be about $15 - 40\%$ higher in practice from the atmospheric turbulences, the vibrations, the atmospheric inhomogeneities, etc...

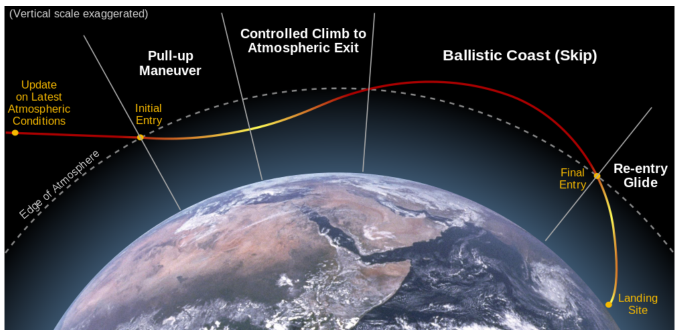

FIGURE 1. The atmospheric re-entry trajectory of the official Apollo Missions.

Entry, Splashdown, and Recovery[57]

	Apollo 7	Apollo 8	Apollo 9	Apollo 10	Apollo 11	Apollo 12	Apollo 13	Apollo 14	Apollo 15	Apollo 16	Apollo 17[58]
Earth Entry											
Velocity (ft/sec)	25,846.4	36,221.1	25,894	36,314	36,194.4	36,116.618	36,210.6	36,170.2	36,096.4	36,196.1	36,090.3
Maximum Entry Velocity (ft/sec)	25,955	36,303	25,989	36,397	36,277						
Maximum g	3.33	6.84	3.35	6.78	6.56	6.57	5.56	6.76	6.23	7.19	6.49
Range (n mi)	1,594	1,292	1,835	1,295	1,497	1,250	1,250	1,234	1,184	1,190	1,190
Geodetic Latitude (deg N)	-29.92	20.83	33.52	-23.60	-3.19	-13.80	-28.23	-36.36	14.23	-19.87	0.71
Longitude (deg E)	92.62	-179.89	-99.05	174.39	171.96	173.52	173.44	165.80	-175.02	-162.13	-173.34
Flight Path Angle (deg E of N)	-2.0720	-6.50	-1.74	-6.54	-6.48	-6.48	-6.269	-6.370	-6.51	-6.55	-6.49
Heading Angle (deg)	87.47	121.57	99.26	71.89	50.18	98.16	77.21	70.84	52.06	21.08	156.53
Lift To Drag Ratio	---	0.300	---	0.305	0.300	0.309	0.291	0.280	0.290	0.286	0.290
Max. Heating Rate (BTU/ft^2/sec)	---	296	---	296	286	285	271	310	289	346	346
Total Heating Load (BTU/ft^2)	---	26,140	---	25,728	26,482	26,224	25,710	27,111	25,881	27,939	27,939
Duration (sec)	937.0	869.2	1,003.8	868.5	929.3	845.9	835.3	852.8	778.3	814.0	801.0
Avg. Radiation Skin Dose (Rads)[59]	0.16	0.16	0.20	0.48	0.18	0.58	0.24	1.14	0.30	0.51	0.55
Earth Splashdown											
GET	260:09:03	147:00:42.0	241:00:54	192:03:23	195:18:35	244:36:25	142:54:41	216:01:58.1	295:11:53.0	265:51:05	301:51:59
KSC Date	22-Oct-68	27-Dec-68	13-Mar-69	26-May-69	24-Jul-69	24-Nov-69	17-Apr-70	09-Feb-71	07-Aug-71	27-Apr-72	19-Dec-72
GMT Date	22-Oct-68	27-Dec-68	13-Mar-69	26-May-69	24-Jul-69	24-Nov-69	17-Apr-70	09-Feb-71	07-Aug-71	27-Apr-72	19-Dec-72
KSC Time	07:11:48 AM	10:51:42 AM	12:00:54 PM	12:52:23 AM	12:50:35 PM	03:58:25 PM	01:07:41 PM	04:05:00 PM	04:45:53 PM	02:45:05 PM	02:24:59 PM
Time Zone	EDT	EST	EST	EDT	EDT	EST	EST	EST	EDT	EST	EST
GMT Time	11:11:48	15:51:42	17:00:54	16:52:23	16:50:35	20:58:25	18:07:41	21:05:00	20:45:53	19:45:05	19:24:59
Splashdown Site	Atlantic Ocean	Pacific Ocean	Atlantic Ocean	Pacific Ocean	Pacific Ocean	Pacific Ocean	Pacific Ocean	Pacific Ocean	Pacific Ocean	Pacific Ocean	Pacific Ocean
Latitude (deg N)	27.63	8.10	23.22	-15.07	13.30	-15.78	-21.63	-27.02	26.13	-0.70	-17.88
Longitude (deg E)	-64.15	-165.00	-67.98	-164.65	-169.15	-165.15	-165.37	-172.67	-158.13	-156.22	-166.11
CM Weight (lbm)	11,409	10,977	11,094	10,901	10,873	11,050	11,133	11,481.2	11,731	11,995	12,120
Distance To Target (n mi)	1.9	1.4	2.7	1.3	1.7	2.0	1.0	0.6	1.0	3.0	1.0
Distance To Recovery Ship (n mi)	7	2.6	3	2.9	13	3.91	3.5	3.8	5	2.7	3.5
Distance Traveled (n mi)	3,953,842	504,006	3,664,820	721,250	828,743	828,134	541,103	1,000,279	1,107,945	1,208,746	1,291,299
Maximum Distance Traveled From Earth (n mi)	244.2	203,752.37	275.0	215,548	210,391						

FIGURE 2. The Official Apollo Mission Data.

Moreover, the maximum G deceleration can be 40.06% lower than the official Apollo 15 atmospheric re-entry maneuver with a lower flight path angle than the official data ($\Theta = -5.0304°$ instead of $\Theta = -651°$) and a push-down maneuver instead of an official pull-up maneuver. However, the heat shield would be solicited a bit more: 29.9 kg heavier heat shield would be needed in the simulation or 44.8 kg heavier heat shield would be needed if the melting of the silica heat shield is not homogeneous at 50%.

Additionally, a another relatively high inconsistency was found with the official Apollo 13 heat shield mass thickness. If the melting of the silica heat shield is not

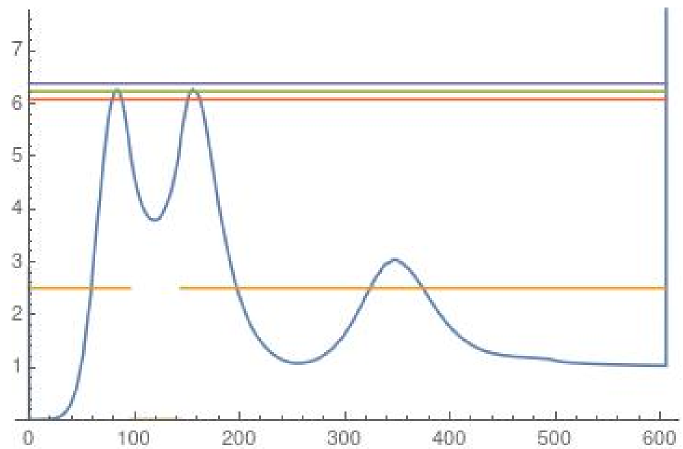

FIGURE 3. The simulated G deceleration of Apollo 15 during the atmospheric re-entry with respect to time and starting at $r_0 = R_{\oplus} + 400\ 000 \times 0.3048$. The yellow horizontal line correspond to a positive lift with a YAW angle of 0° if else, the lift is negative with a YAW angle of 180°. The simulated ratio of silica heat shield melted is 0.565 and the remaining heat shield mass thickness is 30.7 kg/m^2. If the melting of the silica heat shield is not homogeneous at 50%, the simulated ratio of silica heat shield melted is 0.848 and the remaining heat shield mass thickness is 10.7 kg/m^2.

homogeneous at 50%, the heat shield mass thickness is 72.98% smaller than the heat shield mass thickness of the Space Shuttle.

The same inconsistency at a lower level is also found with the official Apollo 15 heat shield mass thickness. If the melting of the silica heat shield is not homogeneous at 50%, the heat shield mass thickness is 68.82% smaller than the heat shield mass thickness of the Space Shuttle.

Moreover, the heat shield mass thickness is already small since the Space Shuttle Columbia (OV-102) disintegrated during the atmospheric re-entry. Since the historical context of the space race with USSR was extremely intense at that time and official data were manipulated for propaganda purposes (Yuri Gagarin himself lies about the fact he has not landed inside the descent module used for the atmospheric re-entry), we can legitimate ask ourself if the failure of Apollo 1 was not during a atmospheric re-entry test with a speed between 9.5 km/s and 11.0 km/s.

Therefore the alternative scenario would be the deposit of extra rocket fuel in lunar orbit with some preliminary Apollo missions in order to slow down the service module before the atmospheric re-rentry and reduce the speed between 9.0 km/s and 10.0 km/s. At 9.0 km/s with the other official Apollo 15 data, the maximal G deceleration is only 3.010 and the remaining heat shield mass thickness 50.5 kg/m^2

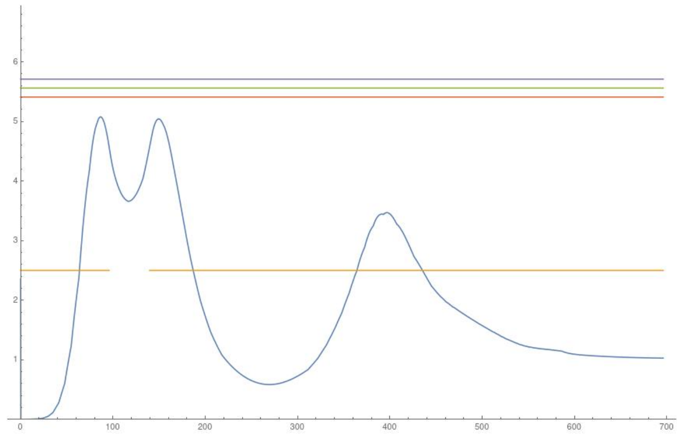

FIGURE 4. The simulated G deceleration of Apollo 13 during the atmospheric re-entry with respect to time and starting at $r_0 = R_\oplus + 400\ 000 \times 0.3048$. The yellow horizontal line correspond to a positive lift with a YAW angle of 0° if else, the lift is negative with a YAW angle of 180°. The simulated ratio of silica heat shield melted is 0.579 and the remaining heat shield mass thickness is 29.7 kg/m^2. If the melting of the silica heat shield is not homogeneous at 50%, the simulated ratio of silica heat shield melted is 0.868 and the remaining heat shield mass thickness is 9.3 kg/m^2.

is quiet large and comparable to the Vostok 1 atmospheric entry module if the melting of the silica heat shield is not homogeneous at 50%. Finally, in this alternative scenario, a second Service Module would be in lunar orbit and could be used to return on earth in the case of the first Service Module failed to leave lunar orbit.

Two interesting coincidence about official Apollo missions data:

1- If the service module of the Apollo missions is completely filled with rocket fuel at the lunar orbit, there is just enough Delta-v to slow down the Apollo command module at 9.00 km/s before the atmospheric re-entry:

$$m_{CSM}^{DRY} = 24\ 520 - 18\ 410 + 5\ 560 + 3 \times 80 = 11\ 910\ kg \tag{14}$$

$$m_{CSM}^{FUEL} = 18\ 410\ kg \tag{15}$$

$$v_{RE-ENTRY} = -\left(log\left(\frac{m_{CSM}^{DRY} + m_{CSM}^{FUEL}}{m_{CSM}^{DRY}}\right) \times 314 \times 9.81 - 852\right) \tag{16}$$

$$+3\ 154 + \sqrt{\frac{GM_\oplus}{R_\oplus + 400\ 000 \times 0.3048}} \tag{17}$$

$$v_{RE-ENTRY} = 8\ 961\ m/s \tag{18}$$

(19)

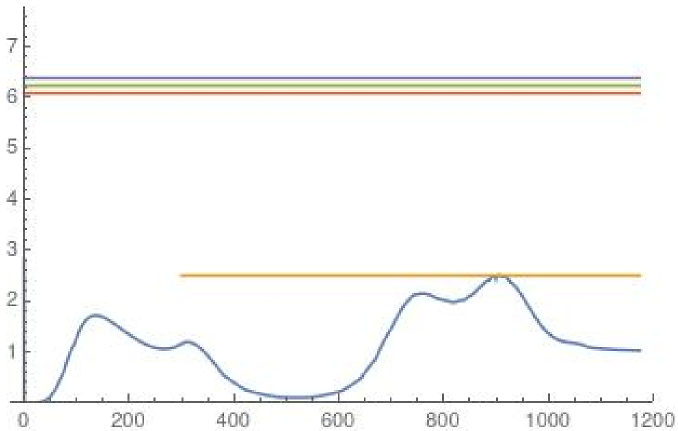

FIGURE 5. The simulated G deceleration of Apollo 15 during the atmospheric re-entry with respect to time and starting at $r_0 = R_{\bigoplus} + 400\ 000 \times 0.3048$. The atmospheric re-entry maneuver minimize the maximal G deceleration down to 3.011 with a lower flight path angle $\Theta = -5.0304°$ than official data and a pull-up maneuver instead of an official push-down maneuver. The yellow horizontal line correspond to a positive lift with a YAW angle of 0°. If else, the lift is negative with a YAW angle of 180°. The simulated ratio of silica heat shield melted is 0.601 and the remaining heat shield mass thickness is 28.2 kg/m^2. If the melting of the silica heat shield is not homogeneous at 50%, the simulated ratio of silica heat shield melted is 0.901 and the remaining heat shield mass thickness is 7.0 kg/m^2.

1- One unmanned Saturn-V flight can also perform a trans-lunar injection for exactly two service modules with only one Service Propulsion (SPS) engine mass:

$$m_{CSM}^{DOUBLE} = 2 \times 24\ 520 - 3\ 000 = 46\ 040\ kg \tag{20}$$

Therefore, one unmanned Saturn-V flight can put the following rocket fuel mass in lunar orbit:

$$m_{FUEL}^{LO} = 2 \times 18\ 410 - 13\ 500 = 23\ 320\ kg = 6 \times 13\ 500\ kg/3.473 \tag{21}$$

$$v_{CSM}^{DOUBLE} = log\left(\frac{2 \times 24520 - 3000}{2 \times 24520 - 3000 - 13500}\right) \times 314 \times 9.81 = 1\ 069\ m/s \tag{22}$$

The official Apollo missions 4, 8, 9, 10 waste a lot of Delta-v and it could be used to transport extra rocket fuel in lunar orbit. The waste of Delta-v were respectively: 100%, 66%, 96% and 66%.

Additionally to a backup Service Module in lunar orbit, it could be smart to have also a backup lunar module in order to have the possibility to rescue the lunar

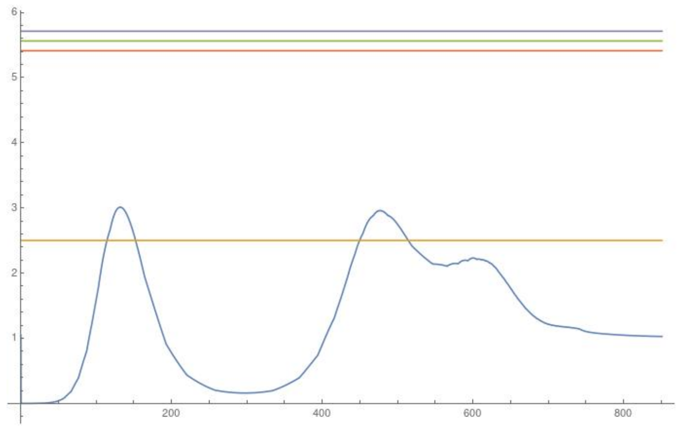

FIGURE 6. The simulated G deceleration of Apollo 13 with a slower speed of 9.00 km/s and at a lower flight path angle 4.65° during the atmospheric re-entry with respect to time and starting at $r_0 = R_{\bigoplus} + 400\ 000 \times 0.3048$. The yellow horizontal line correspond to a positive lift with a YAW angle of 0° if else, the lift is negative with a YAW angle of 180°. The simulated ratio of silica heat shield melted is 0.189 and the remaining heat shield mass thickness is 57.2 kg/m^2. If the melting of the silica heat shield is not homogeneous at 50%, the simulated ratio of silica heat shield melted is 0.284 and the remaining heat shield mass thickness is 50.5 kg/m^2.

crew in the case they could not take off from the lunar surface. Also, the failure of the unique Command Module could be critical and a backup Command Module in lunar orbit would be also smart.

We can also reasonably ask ourself if Apollo 6 or Apollo 13 were not used also to transport some extra module or some extra rocket fuel in lunar orbit. Since releasing information about some extra module or some extra rocket fuel in lunar orbit would make the whole Apollo missions much more vulnerable to USSR interference with their own lunar missions, it would be much smarter to hide the achievements of those Apollo missions with some official partial material failure. Moreover, without those crucial information about some extra module or some extra rocket fuel in lunar orbit, it would be much more difficult for USSR to copy Apollo missions later and to counter the American space propaganda later. Finally, adding officially some fake material failure for some Apollo missions and hiding some extra module or some extra rocket fuel in lunar orbit would publicly show American astronauts much more competent than USSR cosmonaut and the public would also be more concerned and more worried about the lunar success of the American astronauts.It also explain better why NASA was extremely stressed about the USSR lunar mission Zond 5.

We arrive at the following third coincidence:

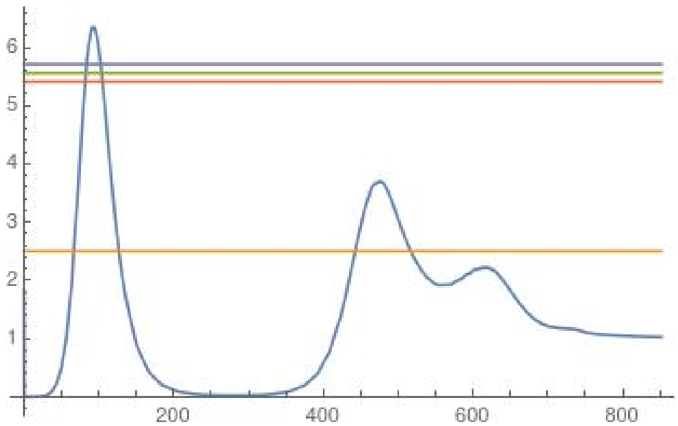

FIGURE 7. The simulated G deceleration of Apollo 13 with a slower speed of 10.00 km/s and at a lower flight path angle 6.25° during the atmospheric re-entry with respect to time and starting at $r_0 = R_{\bigoplus} + 400\ 000 \times 0.3048$. The yellow horizontal line correspond to a positive lift with a YAW angle of 0° if else, the lift is negative with a YAW angle of 180°. The simulated ratio of silica heat shield melted is 0.334 and the remaining heat shield mass thickness is 47.0 kg/m^2. If the melting of the silica heat shield is not homogeneous at 50%, the simulated ratio of silica heat shield melted is 0.501 and the remaining heat shield mass thickness is 35.2 kg/m^2.

$$\Delta m_{LO} = 23\ 320 \times (1 + 1 + (1 - 46.720/140) + (1 - 5.560/140) + (1 - (5.560 + 16.400)/140))) - (6 \times 13\ 500) - 5\ 550 - 16\ 400 = 674\ kg \tag{23}$$

Finally, a weird inconsistency about the earth entry range of Apollo 4 have been found. The official Apollo 4 data suggest the YAW angle was constant and the angle of attack and the lift coefficient and the gliding ratio as well. Therefore, the atmospheric re-entry range is 21.57% larger from the Mathematica simulation than 4 184.3 km from the official Apollo 4 data. And even worse, the maximal G deceleration during the atmospheric re-entry from the Mathematica simulation is 40.30% larger than 7.30 from the official Apollo 4 data.

To conclude, we do not exclude at 100% that the number of successful American manned lunar missions was a bit lower than 6 if a significant number of Apollo Missions failed their objectives. However, it is extremely likely that the number of successful American manned lunar missions were greater or equal to 3 despite the inconsistencies of the official Apollo mission data we found in that article. However, the fastest speed of human in the earth atmosphere is not 11 068.5 m/s except a close speed value for the unsuccessful Apollo 1 atmospheric re-entry but rather 9 000 m/s about. In that article, we have tackled neither the connections between space competition and nuclear deterrence strategy and neither the connection between the large size of Saturn V rockets and the large size of the USSR territory.

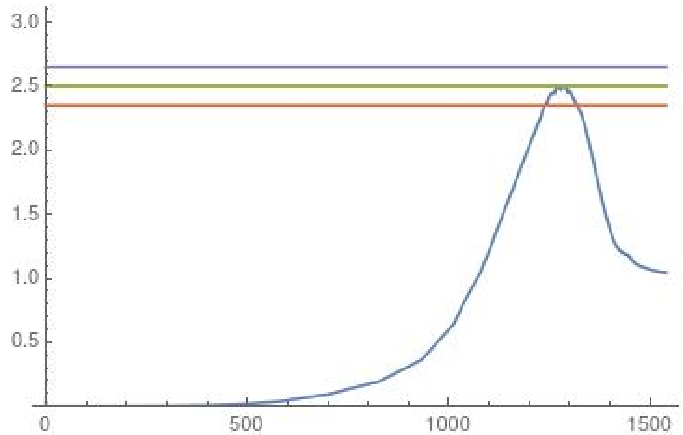

FIGURE 8. The simulated G deceleration of Shenzhou during the atmospheric re-entry with respect to time and starting at $r_0 = R_\oplus + 400\ 000 \times 0.3048$. The simulation was done with an initial circular earth orbit speed and with a flight path angle $\Theta = -0.5°$. The maximal deceleration from the simulation is 2.50 G and it is 37.5% lower than the maximal deceleration of 4 G about that Shenzhou experienced. The simulated ratio of silica heat shield melted is 0.089 and the remaining heat shield mass thickness is 82.2 kg/m^2. If the melting of the silica heat shield is not homogeneous at 50%, the simulated ratio of silica heat shield melted is 0.134 and the remaining heat shield mass thickness is 78.2 kg/m^2.

Finally, that alternative scenario in the present article allow us to understand better why it is so hard to redo a manned lunar landing mission after the Apollo missions since we need few preliminary unmanned lunar missions before the manned lunar landing mission which require a minimum total of 9 000 000 kg rocket about.

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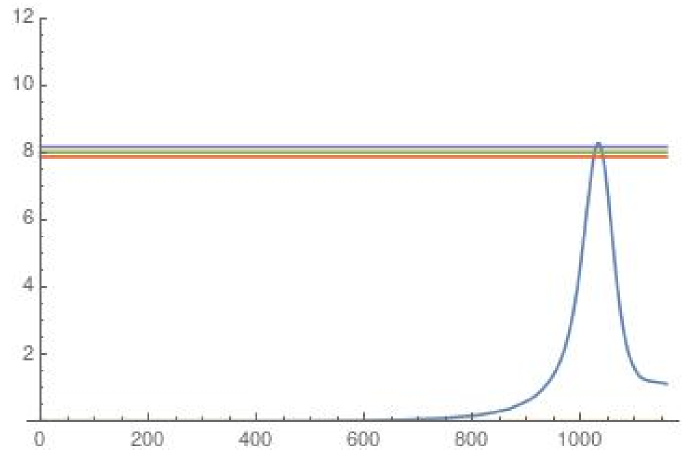

FIGURE 9. The simulated G deceleration of Vostok 1 during the atmospheric entry with respect to time and starting at $r_0 = R_{\bigoplus} + 400\,000 \times 0.3048$. The simulation was done with an initial circular earth orbit speed and with a flight path angle $\Theta = -0.5°$. The maximal deceleration from the simulation is 8.21 G and it is 17.9% lower than the maximal deceleration of 10 G about that Vostok 1 experienced. No heat shield melting.The heat shield mass thickness is 50.4 kg/m^2.

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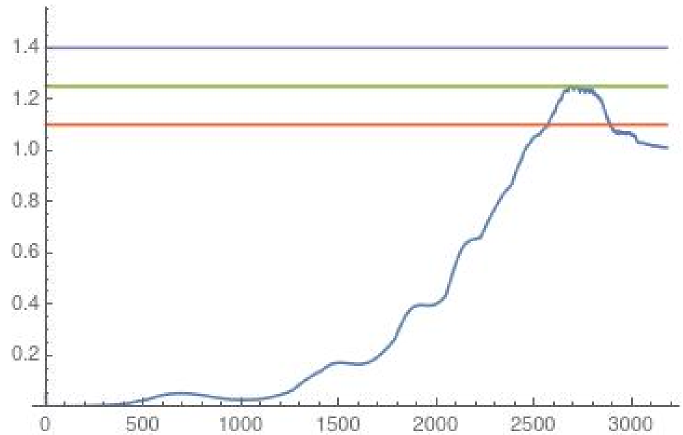

FIGURE 10. The simulated G deceleration of the Space Shuttle during the atmospheric re-entry with respect to time and starting at $r_0 = R_{\bigoplus} + 400\ 000 \times 0.3048$. The simulation was done with an initial circular earth orbit speed and with a flight path angle $\Theta = -0.5°$. The maximal deceleration from the simulation is $1.26\ G$ and it is 26.4% lower than the maximal deceleration of 1.7 G about that the Space Shuttle experienced. No heat shield melting.The heat shield mass thickness is $34.3\ kg/m^2$.

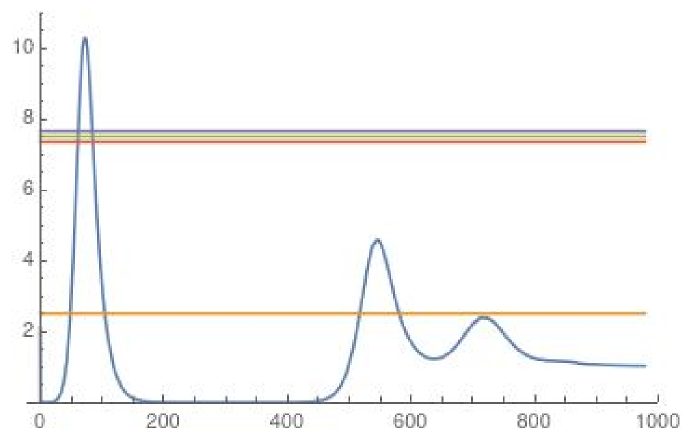

FIGURE 11. The simulated altitude of Apollo 4 during the atmospheriv re-entry with respect to time and starting at $r_0 = R_{\bigoplus} + 400\ 000 \times 0.3048$. The lift is always positive with a constant YAW angle of 0°. The drag coefficient is $C_D = 0.121$ and the glide ratio is $C_L/C_D = 0.360$. The official initial speed is $35\ 333.3\ ft/s \cong 10\ 769.6\ m/s$ and the official initial flight path angle is $-7.50°$. The simulated ratio of silica heat shield melted is 0.399 and the remaining heat shield mass thickness is $42.4\ kg/m^2$. If the melting of the silica heat shield is not homogeneous at 50%, the simulated ratio of silica heat shield melted is 0.599 and the remaining heat shield mass thickness is $28.3\ kg/m^2$.