Principles of Jet Propulsion: A Non-Standard Analysis of the Basic Formulas for Rocket Propulsion Leads to Surprising Results

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We have found a law that connects the speed variation of a body to the throw of part of his mass, using the principle of conservation of momentum. Our results can be used to prove that accelerate is easier than decelerate, and to choose between multiple paths that a spaceship can follow. Using the conservation of momentum and the velocity addition formula we started our analysis from simple examples (likewise a child on a cart), and then moved to more challenging ones (for example in relativistic conditions). After that, using the previously found results, we solved more difficult problems with a surprising outcome. We connected the relativistic formulas that we have found to the Galileian ones, thanks to the Correspondence Principle; then we used these results to prove that accelerate is easier than decelerate: given the same number of throws, the variation in velocity in acceleration is greater than the one in deceleration. This a very counterintuitive result, that cannot be found using the standard rocket propulsion equations (for example the classical rocket equation). Our laws show some interesting and astonishing results, like the acceleration and deceleration one, and can be applied in a number of different situations involving rockets and jet propulsion, for example finding between multiple paths the best one that grants an higher final velocity.