Physics in traditions: the ritual of the owners of the Mexican sky

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Abstract. Mexico is characterized by its innumerable cultural wealth, one of many is present in the state of Veracruz where the Totonaca culture lived, and who were developers of a dance known as "The Papantla Flyers", which is related to the Fertility and fecundity of the earth. This ritual consists of a group of 5 men who climb to the top of a 31-meter pole, tie a rope around their waist and throw themselves headlong into the void with open arms. In this work, we will study the equations of movement associated with the trajectory of men who are thrown into the void, through the theoretical development a design and construction of the experimental model and numerical results by modeling the problem through EJS. And offer a complete solution for two cases a) constant mass and b) variable mass. This problem is treated with the Lagrangian formulation and represents a problem of applied dynamics suitable for the courses of physics, classical mechanics at the university level.

1 Typing Area

Physics Teaching and Learning University.

2 El ritual de los dueños del cielo Mexicano.

2.1 This ritual surprises many people, because the instant that each of the men throw themselves headfirst into the void, we could say that they stayed suspended or that maybe they only moved in a straight line downwards. However, with the experimental model what we will study is: how is it possible that each of these men descends in helical trajectory due to their own weight and to the torque produced by the loop twisted on the pole, figure 1a) and 1b) . In addition, the change of the position on the vertical axis (z) of each man is not linear, as we could see it with the naked eye, however, the change in length in time remains linear for the time of flight.

2.2 It is not enough to analyze the theoretical, experimental and numerical model separately, so we will analyze the three ways of solving it: obtaining the analytical solution, and

experimental results as well as modeling with Easy Java Simulation and we will compare the results between the different solutions

3 The main objective.

3.1 The trajectory of each of the particles obeys a circular movement, and since the primary objective is to analyze the analytical solutions to contrast with the experimental results and the simulation, it will be necessary to make use of generalized coordinates and at the same time use the spherical coordinates, to obtain the analytical solutions of the trajectory that the particles follow..

$$\ddot{\rho} - \rho^{-3}C_1 - C_2 = 0 \qquad (1)$$

$$L_z = C_3\rho^2\dot{\varphi} \qquad (2)$$

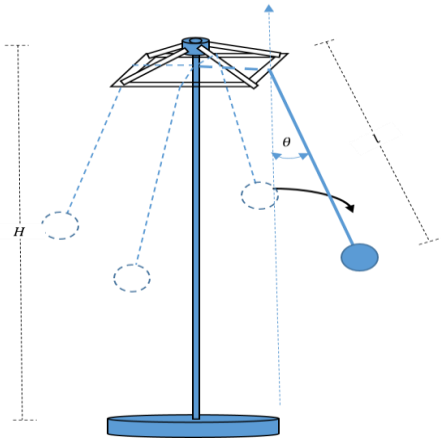

Fig. 1 a) Side view

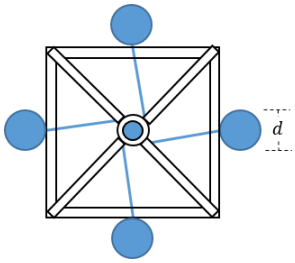

Fig1 b) Top view

3.2 Where Lz is the angular momentum of each rotating flyer, and the constants are related to the mass m of each flyer and the zenith angle θ.

3.3 We will also show what happens with a similar system but now with a variable mass. A relationship is proposed for the mass as a function of time and both the theoretical and experimental parts are developed to show the student a solution for this kind of systems.

4 Conclusion

We can answer if there are changes between the analysis of variable mass system and another where the mass is constant, to compare the angular velocities, the change of the length of the rope in time as well as the position of the particular in the z axis . Including simulation as a tool for the analysis of mechanical systems.

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