Parachutes Optimization by Numerical Simulation

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ABSTRACT

Parachutes were in the past developed mainly to military use; actually, however, they are being employed in many areas, such as to sports, spatial projects, car-race, etc.

A paraglider is a special kind of parachute, of banana form. A difference between the conventional parachute and the paraglider is the jump's altitude. In a jump with parachute, an airplane is employed and the jump must happen between 3000-4000 meters; the parachute is opened around 900 meters from the soil. Before opening the parachute the parachutist can accelerate to 190 km/h in around 40 seconds, which is its maximum velocity. For a jump with paraglider 1200 meters of altitude are sufficient and the jump can be realized from the top of a mountain or other geographic unlevelling.

Another style of parachute is that of automatic opening, where the equipment opens without intervention of the parachutist. The jump is done from a plane at about 1200 meters. Other important application of parachute appears in spatial expeditions, where robots are cast from a rocket or a spatial bus in places not yet explored by the men. The parachute is then designed to avoid a strong crash of sensible equipment with the soil.

The present work develops a numerical method to analyze a jump with a parachute. The set of bidimensional incompressible unsteady N-Stokes equations is solved together with a Poisson's equations for pressure, which comes from N-Stokes and the mass conservation equation. The numerical model is based on the finite difference explicit Runge-Kutta three-stages scheme for second order time and space approximations.

Preliminary results showed to compose well with and analytical simplified model, whose results are shown in Fig. 1, that comes from the following equation

$$m\frac{dv}{dt} = P - P\frac{v^2}{a}$$

where $a = 2400$ when the parachute is closed and $a = 30$ when it is opened.

We strong the fact that there are few information about parachutes and paragliders in the available literature, specially for sport activities; the contribution of our work goes in this direction.

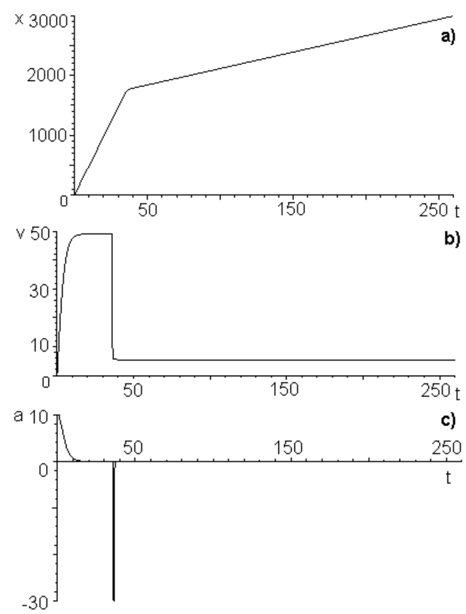

Figure 1: Displacements a),velocity b) and acceleration c) for a conventional parachute jump

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