Modelling the trajectory of a skydiver

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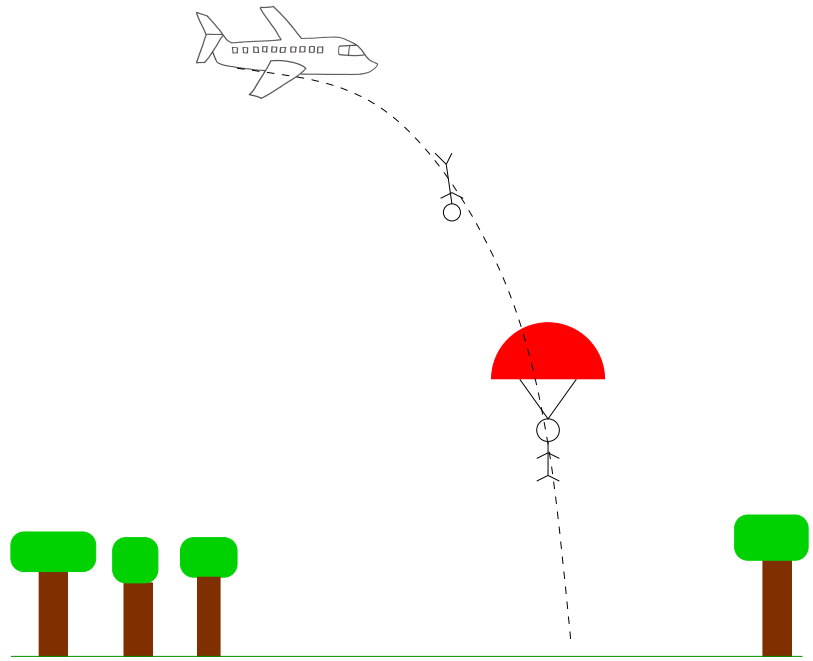
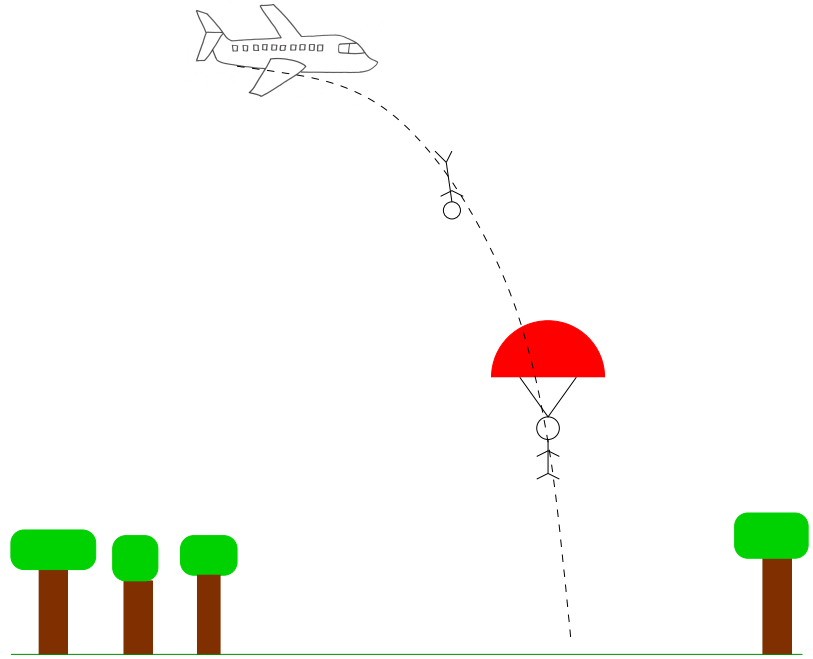
Skydiving

- Risk during skydiving should be minimized
- Cybernetic Parachute Release System (CYPRES)
- Determines height from measured barometric pressure
- Between 1991 and 2003 over 1000 fatal accidents prevented
- Many limitations, needs improvement



Skydiving

- Gravity $\Longrightarrow$ Parabolic trajectory
- Wind drag $\Longrightarrow$ Velocity
- Rotation &
- Positioning $\Longrightarrow$ noise in instrumentation



Earth, atmosphere and diver

- Gravity not uniform and not constant (Newton's Law)

$$g = \frac{GM}{(R+h)^2}$$

- Barometric pressure not constant (Barometric formula)

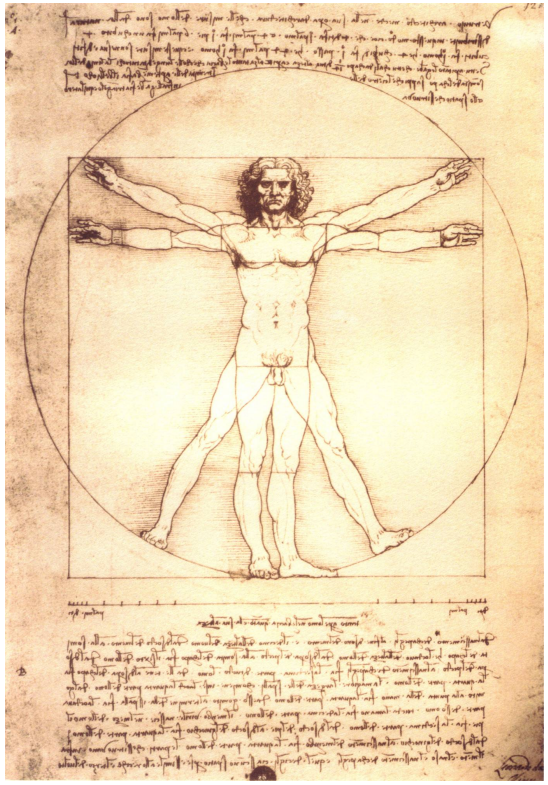
$$\frac{P}{P_b} = \left(\frac{T_b}{T_b + L_b h}\right)^{\frac{gM_A}{R^* L_b}}$$

- Wind drag (Drag formula)

$$D = \frac{1}{2}\varrho v^2 c_D A$$

- Rotation of the diver

Human body



- Drag coefficient and Moment of Inertia depend on posture and positioning

Current Models

- ODE based models: easy to solve but problems with uncertainity
- Stochastic ODEs: require Monte-Carlo methods and are expensive
- CFD models: very expensive computations

New Design and Goals

- Additional measurement of acceleration using triaxial accelerometers
- Sampling rate: 4 measurements per second
- Simple ODE model with noise
- Calibration of data and analysis of noise distribution
- Determination of height and velocity using last few measured data points
- Computation low on resources

Industrial Partner

Dr. Hirsch GmbH, Airtec GmbH & Co. KG Safety Systems

`http://www.cypres.cc`

More Information

`http://en.wikipedia.org/wiki/Automatic_activation_device`