Rules

The 2023 Speed Skydiving Competition Rules include two rules which relate to the validation window. First, we have the definition of the validation window:

> 2.4 VALIDATION WINDOW The validation window is the part of the jump which is used to determine the accuracy of the SMD data. The validation window is 3300ft (1006m) in length, the end of which is determined by the end of the performance window.

Then we have the rule specifying the accuracy requirements within the window:

> 4.1.13 Within the validation window every SMD data sample used for scoring must satisfy precision criteria. Every data sample must have a speed accuracy of less than 3m/s (10.8 kmh). If the accuracy requirement of the SMD data is not met then a re-jump will be given.

Speed accuracy calculation

The rules specify that the speed accuracy must be calculated for each SMD data sample, so we use an estimate of the speed accuracy based on values that can be obtained for a single sample.

For the Speed Skydiving competition, speed is calculated as follows:

$$\text{Speed} = \frac{\Delta\text{Elevation}}{\Delta\text{Time}} = \frac{h_1 - h_2}{3\text{ seconds}}$$

To calculate speed accuracy, we start by determining how errors in elevation measurement affect the calculated speed:

$$\frac{\partial\,\text{Speed}}{\partial\,h_i} = \frac{1}{3\text{ seconds}}$$

Then we calculate the total speed accuracy, σ_{Speed}, given the accuracy, $\sigma_{h,i}$, of each elevation measurement:

$$\sigma^2_{\text{Speed}} = \left(\frac{\partial\,\text{Speed}}{\partial\,h_i}\sigma_{h,1}\right)^2 + \left(\frac{\partial\,\text{Speed}}{\partial\,h_i}\sigma_{h,2}\right)^2 = \left(\frac{\sigma_{h,1}}{3\text{ seconds}}\right)^2 + \left(\frac{\sigma_{h,2}}{3\text{ seconds}}\right.$$

Since we need a calculation which depends only on values obtained for a single sample, we assume that the elevation error at the top, $\sigma_{h,1}$, and bottom, $\sigma_{h,2}$, of the 3 second window is equal to the error for the particular point we're considering, σ_h. That gives us an approximation for speed accuracy:

$$\sigma_{\text{Speed}}^2 = \left(\frac{\sigma_h}{3\ \text{seconds}}\right)^2 + \left(\frac{\sigma_h}{3\ \text{seconds}}\right)^2 = 2\left(\frac{\sigma_h}{3\ \text{seconds}}\right)^2$$

Finally, we take the square root of both sides to get speed accuracy:

$$\sigma_{\text{Speed}} = \frac{\sqrt{2}\,\sigma_h}{3\ \text{seconds}}$$

Values in the FlySight log file

In the FlySight log file, the estimated accuracy for the elevation measurement is given in the `vAcc` column. We can calculate speed accuracy for a given sample as follows:

In [1]:
```
def SpeedAccuracy(vAcc):
    return sqrt(2) * vAcc / 3
```

This value should be calculated for every data sample within the validation window. If any value exceeds 3 m/s, the scoring system should notify judges.