PROPOSAL TO IGC PLENARY 2017
Year 2

Proposed by Spain
Mathematical methods for the calculation of performances in gliding

It is proposed:

A) That a set of definitions and mathematical methods be specified for the calculation of performances in gliding, as outlined below:

1. Unless otherwise noted, geometric calculations will use the WGS-84 ellipsoid earth model, via established Vincenty methods.

2. Bearings relevant to an Observation Zone are always calculated from the Observation Zone coordinates to the point of interest (fix or other waypoints).

3. The time of crossing of a start or finish line will be evaluated as follows: The point of intersection between the start/finish line and the line segment connecting the two fixes each side of the line will be identified. The time of crossing will be linearly interpolated from this, by taking into account the proportional length of each segment. The start time will be rounded down to the nearest second while the finish time will be rounded up to the nearest second. The altitude of crossing the line also will be determined by interpolation as above, and will be rounded to the closest meter. The speed across the line is defined as the distance between the two fixes divided by the time difference between the two fixes.

3. For the evaluation of airspace infringements, the airspace blocks comprising of line segments will be projected into the 2D plane and Euclidian methods will be used. The projection to be used will be Web Mercator.

4. The altitude used for evaluating a flight performance in championships will be the pressure altitude measured by the flight recorder corrected by an offset value such that the altitude on ground before take-off is equal to the elevation of the airfield as published in the local procedures. No correction of the measured altitude with the calibration chart of the Flight recorder shall be performed. In an event where the local procedures specify feet as the official unit of altitude, altitudes published in feet will be rounded to the closest meter for all sporting-related calculations.

If there is no way to establish an altitude baseline before takeoff from the flight recorder data, the relevant sporting section and local procedures will define the penalties and methods to remedy this situation.

5. Airspace files for the scoring of championships will comply to the following guidelines:

- The airspace blocks will identify only penalty airspace and wave windows
- The included airspace blocks will be defined as:
    - Closed polylines comprising of line segments and/or circular arcs
    - Circles of specified radius

- Height limits of airspace blocks will include the following options: ground, height MSL, pressure altitude and unlimited
- Airspace blocks need not conform to the geometry of published airspace but may instead include added buffer space or simplified geometry to suit the competition needs, ensure flight safety or simplify scoring (e.g. by replacing a complex open-ended border geometry by a simple polygon border)
- Airspace files used for scoring should be made available in formats that are not proprietary, although they may be published in other formats

B) That these methods and definitions will be published in a new Annex to SC3 to be management and maintenance by the Software Scoring Working Group under the supervision of the IGC Bureau, which will review and approve any proposed changes. The scope of the SSWG's work under these terms will be limited to the mathematical methods and definitions needed for evaluating gliding performances. The changes will be finalized for publication at the Plenary each year and will come into effect in October of each year.

This proposal affects:

SC3, Annex A

Discussion:

While our Sporting Code sufficiently specifies the rules of our sport there is no specific guidance on the methods used to actually evaluate these sporting performances. The limitations of real-world measuring and the mathematics of approximating the earth's geometry mean that there is often no way to exactly calculate certain properties. What we have instead is a choice of various mathematical methods, often approximations, each of which provides a subtly different result. This means that the choices scoring software programmers and avionics instrument manufacturers make actually influence the results we may get.

In the interest of creating a fair and level playing field for our competitors and a workable set of the methods for our software developers and avionics manufacturers, it is important to define a specific set of rules so as to ensure a consistency of results. This is needed so that we can ensure that the results we get is the same, regardless of the brand of scoring system used, but also that it is possible for the pilot to be confident that what they see in their cockpit instruments can correspond to what the scoring system will evaluate.

In choosing the appropriate mathematical methods, it is important to ensure accuracy of measurement but also practicality of the proposed solution, both in the scoring system and in the cockpit. The proposed principles seek to address this balance in the best possible way for the practice of our sport.

While the mathematic principles governing our sport are not going to change any time soon, technical standards, hardware capabilities and regulatory needs do change. We thus feel it is necessary to

establish a process to maintain these rules. This is why we propose that the Software Scoring Working Group take charge in reviewing these rules and making changes and additions, under the guidance of the IGC Bureau, where this is felt necessary for technical reasons.