Reader Comment

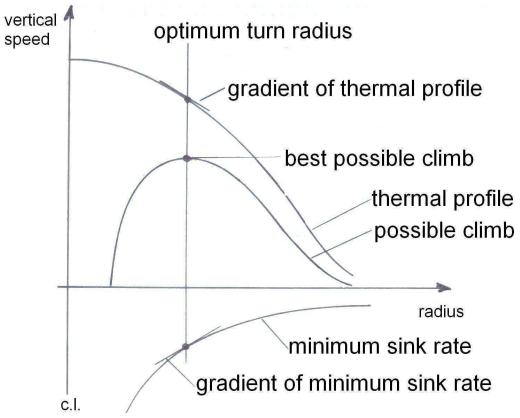
"Swarm Data Mining for the Fine Structure of Thermals" (*TS 36(4)*)

Technical Soaring welcomes correspondence on articles appearing in the journal. Comments may be submitted for publication provided that the article or note appeared within the previous two years. The author is afforded an opportunity to respond. Guidelines for preparing comments and details of the author response procedure are available at the OSTIV website. With this issue, we present the first such Reader Comment.

Alfred Ultsch is to be commended for his novel and ambitious attempt to derive real-world structural models for thermals from flight recorder data ("Swarm Data Mining for the Fine Structure of Thermals," Technical Soaring 36(4), October, 2012). The concept of using readily available GPS flight recorder data from world class pilots thermalling in the same sailplanes in a standard thermal during a contest is a valuable tool to gain insight into thermal profiles.

However, difficulties with the underlying assumptions, data reduction, and data analysis need to be recognized.

The basic data source is the statistical summary of the achieved climb rates of world class pilots competing at the World Gliding Championship 2012 in Uvalde thermalling in "standard" Uvalde thermals in the same sailplanes. These pilots can be assumed to achieve iteratively and intuitively the best climb rates at the optimum radius, as illustrated in the following schematic:



The underlying premise for the data reduction seems to be that the radial distribution of achieved climb rates in Uvalde adjusted for sailplane sink rates represents a Uvalde thermal profile. However, if the "achieved climb rates" shown in Fig. 3 (of the article) are based on one standard thermal (as implied throughout the article) there should only be a single value (with some statistical scatter) at an optimum radius. If they were based on a variety of thermals they would describe a limited curve (but certainly not all the way to zero turn radius). More importantly however, these data provide no information about the thermal profile except for the value of the thermal profile at this optimum radius and the associated gradient (i.e. the negative of the sink rate gradient) for a given thermal!

The captions for Figs. 3 to 5 are misleading. Figure 3 obviously shows "Achieved Climb Rates"; Fig. 4 should say "Estimated Vertical Updraft Velocities"; and Fig. 5 should say something like "Updraft data adjusted to match expected results."

Regarding the data analysis, the apparent application of a uniform sailplane sink rate of about 1.05 m/s (the step from Fig. 3 to Fig. 4) from the center to the largest radii, rather than bank angle (or radius) adjusted sink rates (standard text book approach) is puzzling. Even more so considering the statement in the text: "Using the L/D of the particular aircraft the sink rate in the turn was estimated."

Particularly concerning is the "rescaling" of the updraft data in Figs. 4 and 5 by a factor of almost three, which is then used for the following analysis. It appears, that this was done to ensure that the method predicts zero updraft velocity at large radii. However, the fact that this would even be required raises serious questions about the data reduction.

In summary, the derivation of a typical Uvalde thermal profile is based on questionable assumptions and questionable interpretations of the measured data. The data reduction is suspect, the effects of density altitude and bank are inadequately addressed, and the results are manipulated for convenience. Hence, the proposed GTB model cannot be considered to be adequately supported by the experimental data, and as such, remains an interesting hypothesis.

That having been said, the effort was laudable and will hopefully stimulate further research to model thermal profiles.

Sincerely,

Fred Hermanspann
Seattle, Washington, USA

The Author Replies:

Data from flights not specifically made for the purpose of meteorological research were analyzed by techniques and methods that are state-of-the-art in knowledge discovery by an expert who has published experience in data analysis.

The results of the analysis are: as many pilots report, the vertical speed in the center of the thermal is much lower than the standard models (Gaussian) predict. Furthermore a Kelvin-Helmholtz type wave could be isolated at the outer rim.

A model that can explain the distribution of the vertical velocities consistently — the GTB model — was proposed. It is consistent with the data and has a plausible interpretation in atmospheric physics.

The IGC flight recorder files are publicly available. It would be interesting to see Fred Hermanspann's analysis of these data.

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