Real Leading Points

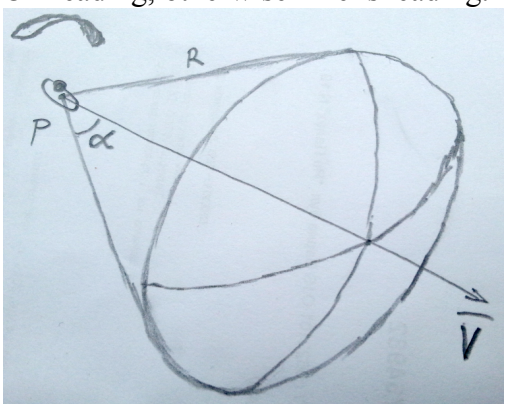
Bulgarian proposal for CIVL Plenary
February 2017 – Salzburg, Austria

What is the goal:

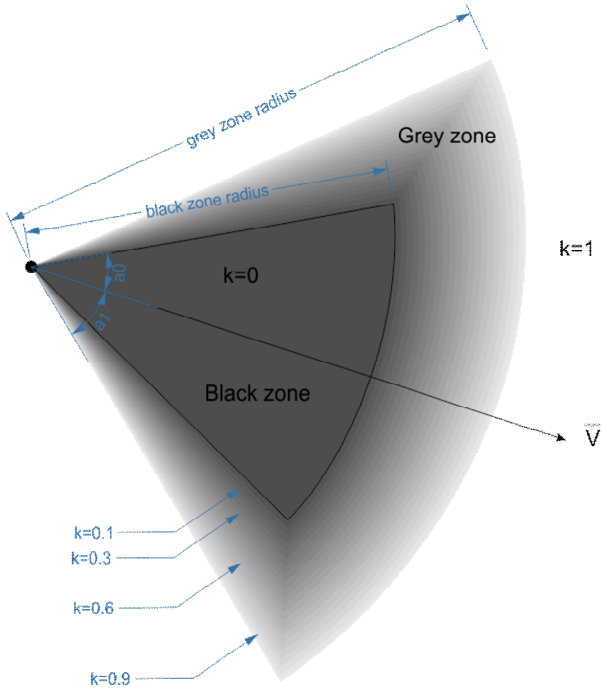
Leading points should represent how long the pilots lead in front of other pilots. Leading a group of pilots brings tactical risks and should be rewarded appropriately.

What is the model:

The idea how to judge leading could be realized with a model we call "spotlight model". When a paragliding pilot flies in 3D space he has position and movement (speed) vector. Imaginary spotlight cone with a tip at the pilot's position and axis – the movement vector can be used to determine if the pilot follows someone else or leads. If there are other pilots in the volume of the pilot's spotlight cone – he is NOT leading, otherwise – he is leading.



The movement vector **V** should be integrated for some time (20 ÷ 30 seconds) to smooth the fluctuations. The spotlight cone must be with "black zone" and "grey zone". Black zone is smaller and if there other pilots inside it – you don't get leading seconds at all. Grey zone is bigger and if there are other pilots inside it – you get fractional leading seconds proportional to the distance to the boundaries of the two zones. If there are more pilots inside the zones – your leading seconds should be the minimum of all values.



The new way of calculating:

Currently the leading points are calculated from one component – curve representing distance over the course of the task by the task time. The surface under the curve is normalized (for all pilots) to "leading coefficient" between 0 and 1. Our proposal is to rename this component to "progress coefficient" and to add second component called "leading coefficient". The new leading coefficient to be calculated from pilot's leading time in relation to the total time spend in glides/transitions and this relation to be normalized for all pilots between 0.2 and 1. Finally the two coefficients to be multiplied with leading weight to form final leading points for the pilot.

The special cases are:

- When you thermal – leading and total time accumulation is turned off. Themaling mode must be detected by the angle between vertical axis and your averaged movement vector. If the angle is less than some value – you are in thermaling mode.
- Pilots who land or make the goal disappear from the model and don't reduce anymore other's leading time.
- In case of stopped task – leading and total time accumulation stops for all pilots at stop time.

What will be the consequences:

The above idea if implemented in the scoring will bring following results:

1. **Pilot A** leading the first gaggle through the whole task will have maximum leading to total time ratio, leading coefficient equal to 1, progress coefficient equal to 1 and finally will get 100% of the available leading points.
2. **Pilot B** following the **Pilot A** through the whole task will have close to zero leading/total time ratio, 0.2 ÷ 0.3 leading coefficient, progress coefficient close to 1 and finally will get about 20 ÷ 30% of the available leading points.
3. **Pilot C** leading the second gaggle through the whole task will have maximum leading/total time ratio, leading coefficient equal to 1, progress coefficient 0.8 ÷ 0.9 and finally will get 80 ÷ 90% of the available leading points.
4. **Pilot D** who makes the task far behind all other pilots, flying the whole task alone will get maximum leading time, leading coefficient equal to 1, but will get 0 progress coefficient and finally will get 0 leading points.

How to choose the parameters?

The movement vector integration time ***I*** should be minimum, but at the same time long enough to integrate the circling in the thermals and to give upward vector. Normally pilots make one circle when thermaling for 20 to 30 seconds.

The size and shape of the spotlight cone are defined by 4 parameters – the sphere radius ***R*** and the angle between the axis and side surface α for black and grey zone. The radii should be lower and upper limit of the distance that separates one group of pilots from the next one. The angles should be the lower and upper limit of the angle a pilot is looking sideways for other pilots to take decisions.

Proposed values are:

Black zone angle (a0) = 45°	Grey zone angle (a1) = 60°
Black zone radius = 1500 m	Grey zone radius = 2000 m
Thermaling angle = 60°	Movement vector averaging time = 20 s

Calculation procedure and formulas:

Here is a brief description how the idea could be implemented in the scoring:

Step 1 – calculate the leading time LT_i and TT_i for all pilots

For every pilot *i* flown the task do:

Let $LT_i = 0$, $TT_i = 0$

For each second between start and landing/finish do:

Calculate the average movement vector $\mathbf{V}_i$

Let $k = 1$, $K_i = 1$

For every other pilot *j* ($j \neq i$) do:

Let **Z** is the vertical unit vector

If $\arccos((\mathbf{Z} \bullet \mathbf{V}_i) / (|\mathbf{Z}| * |\mathbf{V}_i|)) > 60°$ do:

Let **U** is the vector between P_i position and P_j position

Led $d = |\mathbf{U}|$

Let $\alpha = \arccos((\mathbf{U} \bullet \mathbf{V}_i) / (|\mathbf{U}| * |\mathbf{V}_i|))$

If $d < 1500$ m and $\alpha < 45°$ do:

Let $k = 0$

Else if $d < 2000$ m and $\alpha < 60°$ do:

Let $k = (\alpha - 45)/(60 - 45) * (d - 1500)/(2000 - 1500)$

If $k < K_i$ do:

Let $K_i = k$

Let $LT_i = LT_i + K_i$, $TT_i = TT_i + 1$

Step 2 – calculate the leading coefficient LC_i for all pilots

For every pilot *i* flown the task do:

Let $r_i = LT_i / TT_i$

Let $LC_i = 0.2 + r_i * (1 - 0.2)$

Step 3 – calculate the progress coefficient PC_i for all pilots

This step is performed in the current scoring and doesn't need any change.

Step 4 – leading points for a pilot *i* is $LP_i = PC_i * LC_i *$ LeadingWeigth

Implementation and testing schedule:

If the proposal is approved in February 2017 – it will need some intensive development and testing for approximately 50 work hours or calendar time approximately 3 months (we do this in our free time). After the implementation we propose CIVL Bureau to choose few competitions during the European 2017 season to be made with parallel scoring (current leading points and the new real leading points). Official results should be made by the current formulas. If the test competitions show that the proposal goals are achieved – we can use the new real leading points from 2018 in Category 1 events and of course all Category 2 events.

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