CIVL 2020 PLENARY – ANNEXE 30
SOFTWARE WORKING GROUP PROPOSAL — CHANGES TO SECTION 7F
VERSION 0.1

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1 Overview of changes

1. Change definition of task distance

2 Explanations

2.1 Change definition of task distance

Currently, we split the task in two parts, and find the optimized route through those parts separately:

1. Launch to ESS
2. Optimized ESS touch point to goal

This leads to a route that corresponds with how most pilots will approach ESS: The shortest path to ESS, which will touch ESS at a different point from the shortest path to goal, if ESS is followed by one or more turnpoints, including goal.

Unfortunately, as was pointed out by Daniel Dimov, this can lead to vastly blown up task distances in certain edge cases, mainly in out-in-out tasks with large cylinders. This is relevant because both task distance and speed section distance influence the scoring.

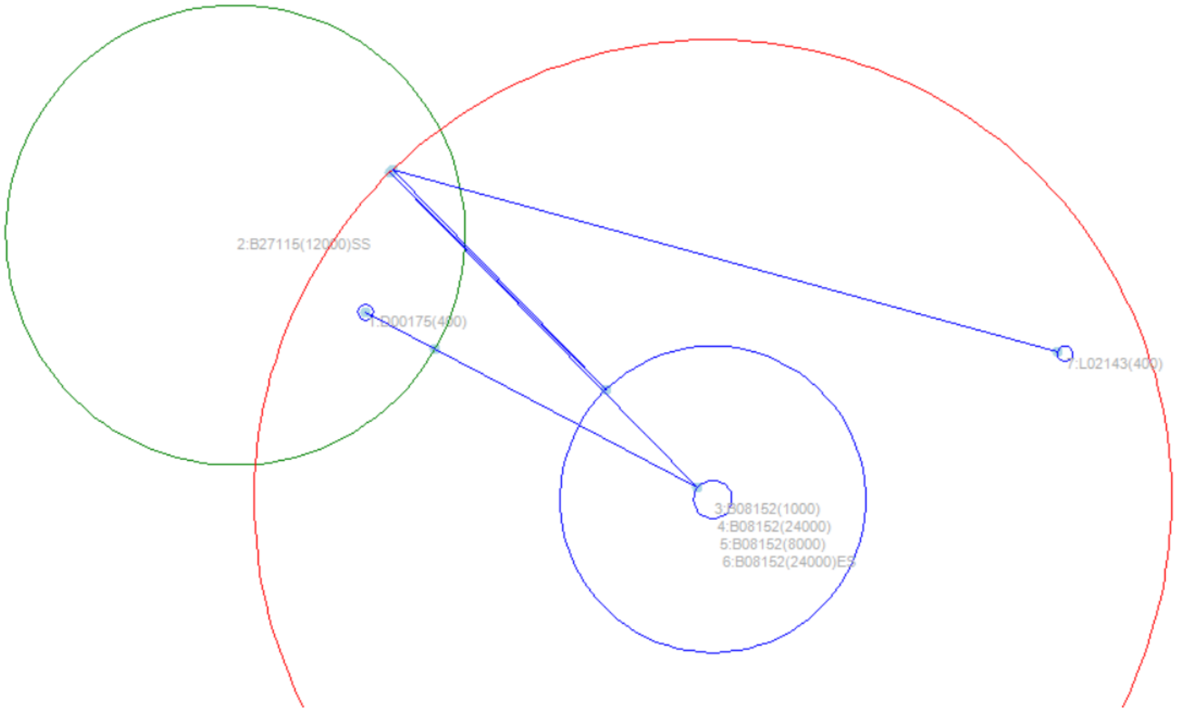

Figure 1: Current optimization, task distance is 110 km

Therefore, we propose to calculate task distance as the optimal route from take-off to goal, and ESS distance as the optimal route from take-off to ESS minus the pre-start portion of the task.

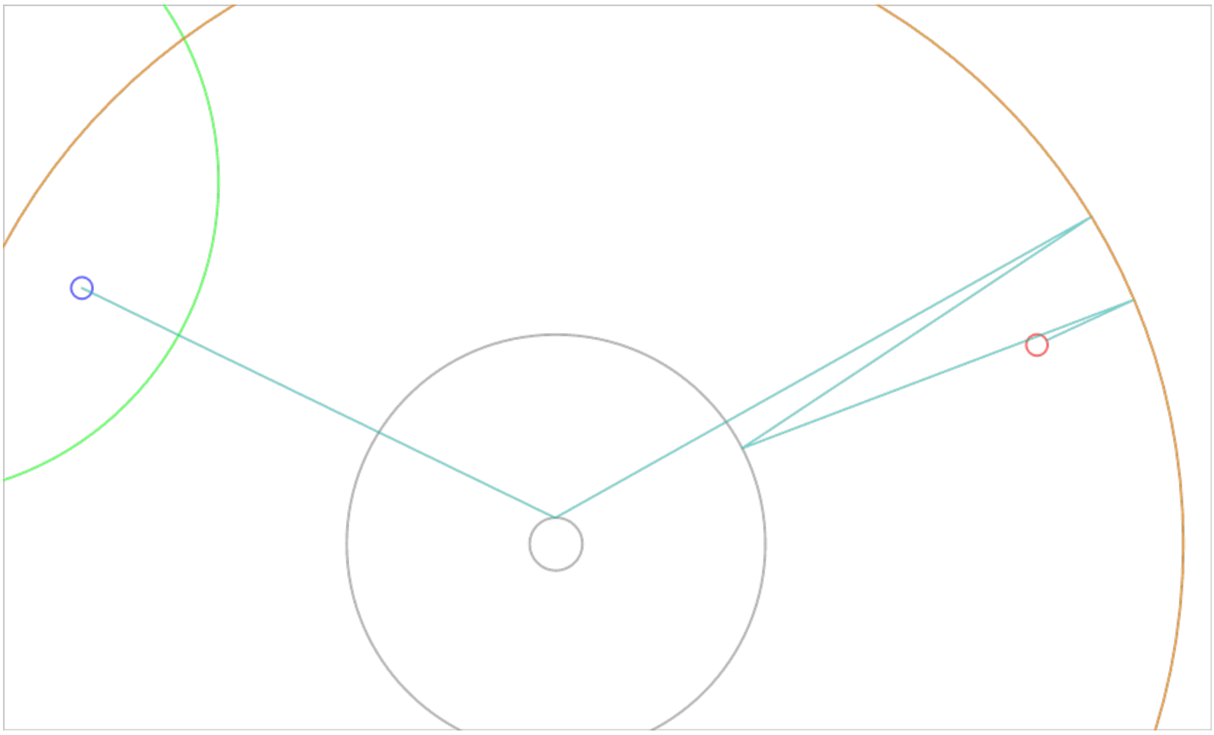

Figure 2: Proposed optimization, task distance is 79 km

3 Changes in Detail

3.1 6.4.2 Task distances

3.1.1 Status quo

Task distance is defined as speed section distance plus any distance pilots need to cover before or after the speed section:

$$launch = \mathrm{point}(lat_{launch}, lon_{launch})$$

$$taskPart1 = \left\{\begin{matrix} launch, \\ preTurnpoint_1, \dots, preTurnpoint_m, \\ startOfSpeedSection, \\ turnpoint_1, \dots, turnpoint_n, \\ endOfSpeedSection \end{matrix}\right\}$$

$$taskPart1Path = \mathrm{getShortestPath}(taskPart1)$$

$$taskPart1Distance = \mathrm{pathDistance}(taskPart1Path)$$

$$preSpeedSectionDistance = \mathrm{pathDistance}(taskPart1Path[0..startOfSpeedSectionIndex])$$

$$\boldsymbol{speedSectionDistance} = taskPart1Distance - preSpeedSectionDistance$$

$$postSpeedSectionDefinition = \left\{\begin{matrix} taskPart1Path.point_{last}, \\ postTurnpoint_1, \dots, postTurnpoint_n, \\ goal \end{matrix}\right\}$$

$$postSpeedSectionPath = \mathrm{getShortestPath}(postSpeedSectionDefinition)$$

$$postSpeedSectionDistance = \mathrm{pathDistance}(postSpeedSectionPath)$$

$$\boldsymbol{taskDistance} = \begin{pmatrix} preSpeedSectionDistance \\ +speedSectionDistance \\ +postSpeedSectionDistance \end{pmatrix}$$

3.1.2 Proposal

Task distance is defined as the distance of the optimized path from launch to goal. Speed section distance is defined as the distances of the optimized path from launch to ESS, minus the distance of the pre-start portion.

$$launch = \text{point}(lat_{launch}, lon_{launch})$$

$$task = \left\{\begin{matrix} launch, \\ preTurnpoint_1, \ldots, preTurnpoint_m, \\ startOfSpeedSection, \\ turnpoint_1, \ldots, turnpoint_n, \\ endOfSpeedSection, \\ postTurnpoint_1, \ldots, postTurnpoint_n, \\ goal \end{matrix}\right\}$$

$$taskPath = \text{getShortestPath}(task)$$

$$\boldsymbol{taskDistance} = \text{pathDistance}(taskPath)$$

$$launchToESS = \left\{\begin{matrix} launch, \\ preTurnpoint_1, \ldots, preTurnpoint_m, \\ startOfSpeedSection, \\ turnpoint_1, \ldots, turnpoint_n, \\ endOfSpeedSection \end{matrix}\right\}$$

$$launchToESSPath = \text{getShortestPath}(launchToESS)$$

$$launchToESSDistance = \text{pathDistance}(launchToESSPath)$$

$$preSpeedSectionDistance = \text{pathDistance}(launchToESSPath[0..startOfSpeedSectionIndex])$$

$$\boldsymbol{speedSectionDistance} = launchToESSDistance - preSpeedSectionDistance$$

3.1.3 Reasoning

With the proposed change, pilots may choose a different point to touch the ESS cylinder than the one suggested by route optimization, resulting in them flying a longer distance than the calculated task distance.

In general, it is accepted that pilots fly further than the task distance to complete a task. On the other hand, a pilot flying less than the task distance, and still completing the task appears to be wrong. But with the current definition of task distance, that will be possible. With the proposed change, we remove that possibility