CGTRK Scrub for Planner

V1.1

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CONTENTS

LIST OF ALGORITHMS

No table of figures entries found.

LIST OF CODE

No table of figures entries found.

LIST OF FIGURES

No table of figures entries found.

LIST OF EQUATIONS

No table of figures entries found.

LIST OF SNIPPETS

No table of figures entries found.

LIST OF TABLES

DOCUMENT REVISION HISTORY

Version Date	Comments
Sep 03, 2015	
Sep 07, 2014	JRF modified, all changes accepted
Sep 14, 2015	Formatting and header issues cleaned up

1.   INTRODUCTION AND SUMMARY

These are the notes that I took during the meeting of Sep 3, 2015, with Jack Frost on the selected items in CGTRK. The tasks discussed at this meeting all related to back-end work on Sim and Planner. Most of this discussion was on Planner.

1.1   2788

Task 2788 is an "umbrella task" for back-end Planner and, as such, is the major task. In fact, if we focused exclusively on the subtasks listed below for 2788 until we had them installed with preliminary testing, we almost certainly would re-visit most of the other back-end Planner tasks. 2788 lists several subtasks, but the critical ones for the near future are:

2786: Planner Optimize Patterns Vice Rectangles
1937: Planner Not Effort Constrained- Can Use Less Than Allocation per SRU
1554: Separation Requirements for Aircraft SRUs
2789: Planner Correct Squatters Rights Problem
2790: Planner Horizontal and Vertical Separation for Aircraft

TABLE 1: SUBTASKS OF 2788

2786 is the key to improvements to Planner. Right now, patterns are inferred indirectly by fitting them to boxes, and Planner optimizes the boxes. We are recommending that we change the way Planner operates and have it build patterns first and then fit exclusion boxes around patterns.

1554 and 2790 are largely duplication, especially in the near future; Planner will not be able to affect vertical separation until 2786, 2937, and 2789 are addressed. This makes 2790 a "vertical separation" task, and it has to be deferred.

For the rest of §1, consider a single SRU and call it SRU1. Since SRU1's box is determined by the 5 numbers:

CenterLat
CenterLng
Orientation
Length
Width

TABLE 2: CURRENT DECISION-VARIABLES

Planner's job is to pick good values for these 5 numbers. We call these 5 variables *Decision-Variables*. Planner uses the resulting box as SRU's exclusion polygon, and generates a pattern that fits this box.

In 2786, we would use as our decision-variables:

StartLat

StartLng
First-leg-length
Second-leg-length
Direction-of-first-leg.

TABLE 3: PROPOSED DECISION-VARIABLES

Given these 5 variables and on-scene endurance, we would use an algorithm to generate a pattern. A simple version of this algorithm would be to simply generate a ladder pattern until the endurance is used up. This algorithm could be enhanced to consider land and other unvarying features. Note: Second-leg-length would be signed (+/-) to indicate first turn right or first turn left.

For the rest of this memo, we will call this algorithm Algorithm-A.

Regardless of what Algorithm A is, it will result in a pattern and we would fit a convex polygon around it (using a fixed buffer; see 1554 and 2790) to serve as SRU1's exclusion polygon.

If we added a decision variable "amount of time used," the pattern-generating software would simply quit when that amount of time is used (see 2937).

Finally, this framework would allow us to at least try to use non-linear optimization methods. We have relatively few variables (5 or 6 times the number of SRUs), and continuous optimization techniques could be useful. If instead, we wished to retain the "Major-Move/Minor-Move" paradigm of the current Planner, there would be work required for the "Minor-move" part.

In short, 2786 is the key to 2788, which is the real precursor to other back-end Planner work.

2.   BACK-END PLANNER

2.1   2788

The 5 tasks listed in Table 1 are summarized in 2788. We could eliminate either Table 1's tasks or 2788.

The other tasks mentioned in 2788 are given in Table 4:

2774: Better Modeling of Turns and Cross Legs
2703: Set Additional Search Pattern Constraints
2474: Revise Planner Workflow for Add Sortie
2381: Pattern Placement Issues and CSP of Transit
2352: Get Initial Patterns with Overlap Allowance
2221: Allow User Edit of Sortie Endurance
1912: Ideas for Optimization of VS/SS, Splitting Sorties Between Pattern Types

TABLE 4: OTHER SUBTASKS LISTED IN 2788

2774 would be part of Algorithm-A, 2474 and 2221 are not part of the back-end, and 2381 could be addressed by Algorithm-A. 1912 should be deferred until 2786 is in place.

2774's primary concern is that we currently model turns as immediate with searching commencing immediately on the subsequent leg. We could address this in Algorithm-A by having Algorithm-A generate a sequence of search legs rather than simply a sequence of waypoints. This set of search legs would then be used when computing POS.

Planner evaluates search legs now, but simply derives them as consecutive pairs of waypoints from the pattern.

2703 addresses constraints on the search patterns. We would start by allowing constraints on the 5 variables of Table 3 and adjust Planner's algorithm to deal with those either with the non-linear solver or manually.

2.2   NON-2788 TASKS

2.2.1   2762: DISALLOW 0 TRACK-SPACING

We'll table that discussion right now. It's simple to disallow it, but perhaps there are times when it would be useful.

2.2.2   2695 MAX THEORETICAL POS

Code for this is already there and producing a number. It has not been tested.

2.2.3   2688: PATTERN SUMMARY MISSING CORNER

This is a bug that hasn't been seen for quite a while, so I suggest we close this.

2.2.4   2517: PLANNER NOT IMPROVING

I would table this. There are cases where Planner is cycling through the same set of solutions. In that case, Planner is not going to improve. Planner can also be stuck making microscopic improvements and in *that* case, Planner will not appear to be improving.

These are both issues and the internal Planner GUI has observed them (they cannot be observed in the SAROPS GUI). However, addressing 2517 before addressing 2786 would be lost effort. It's best to keep 2517 in mind and simply see how 2786 affects it.

Note that the user can abort the Planner if it Planner appears to be unable to improve.

2.2.5   2381: PLANNER SHOULD CONSIDER TRANSIT

There is currently code in Planner that does this. If one gives an SRU a launch Lat/Lng and possible Recovery Lat/Lngs, Planner will subtract the distance to the center of the box from the Launch Lat/Lng and the closest Recovery Lat/Lng and use the remaining path for computing POS.

This is hardly tested and perhaps this approach is too crude.

2.2.6   2368: PROBABILITY IS 0 FOR A SEARCH OBJECT

Perhaps such cases shouldn't even get to Planner. Regardless, it has been addressed on both the GUI side and the back-end, and this report should be closed.

2.2.7   2352: ALLOW INITIAL OVERLAP

A flag could be sent to Planner (or detected by a very small non-zero amount of time given for optimization) to indicate "don't bother clearing overlap." This would allow "GetInitial" to return more quickly. This is fairly easy and could have a major impact on performance.

The biggest issue here is on the GUI side; how do we make sure that this is not considered a "real potential solution?"

2.2.8   2325: ROUNDING ISSUES

Consider estuary. Current Rounding Algorithm is given in the appendix

2.2.9   2236: DUP OF 2381
2.2.10   2100: VS PATTERN TYPE ORIENTATION AND AND CENTER

Defer this until after 2786. Also redundant with 1912.

2.2.11   1938: WARN USER WHEN EXCESS EFFORT IS USED

This could be accomplished with rough calculations on the GUI side.

2.2.12   1937: EXCESS EFFORT

Part of 2788.

We would want to address this with a modified objective function. Currently, we are simply maximizing POS. We could maximize "$M \times POS - m \times hours$," where M is a large number representing the value of a successful

search, and m is a small number representing the value of an hour of search effort.

2.2.13   1934: NEW PATTERN SUMMARIES FOR SRU NAV INPUTS

Strictly GUI side.

2.2.14   1912: VS/SS, SPLITTING SORTIES

Part of 2788. Deferred until after 2786.

2.2.15   1839: AREA SEARCHED

This is *not* Area Effectively Searched. This is a GUI issue but they might want help computing the area of the union of rectangles.

2.2.16   1555: SEARCH AREA DECONFLICTION

Dup with 2788

2.2.17   1554: SEPARATION REQUIREMENTS:

Dup with 2788

2.2.18   1511: REQUEST FOR TRANSIT TOOL

Strictly GUI.

2.2.19   570: AREA OF TRACKLINE SEARCH USING "UNION OF RECTANGLES"

Dup with 1839.

2.2.20   301: INDICATE WHICH PATTERNS ARE OVERLAPPING

Planner can put this in a report. This is straightforward.

2.2.21   193: ENHANCE PLANNER

This is a dup with 2788.

2.2.22   192: IMPORT SRU TRACK DATA FOR PREVIOUS SEARCHES

Deferred.

2.2.23   186: EVALUATE HOT SPOTS

This is because Planner sometimes ignores a small hot spot. We need a good test case with 2 hot spots, one with about 65% of the probability, and one with 35% of the probability. This case should also have a single Object Type. Two identical SRUs.

2.2.24   185: MINOR MOVES FOR A GROUP OF SRUS

We should have, as a potential "minor move," shifts, and rotations, of the SRUs together. This would be best if we identified SRUs in a cluster and adjusted only the SRUs in a cluster.

2.2.25   172: PATTERN TYPES OTHER THAN CS/PS.

Dup with 1912. Also requires more discussion since the last time this came up, it was decided not to do this.

2.2.26   170: VERTICAL AND HORIZONTAL SRU SEPARATION

Dup with 2790. Planner will not address vertical separation in the near future.