The GAISS project

(Geographically Aware Information Support System)

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The availability of powerful portable computers, and live position reporting technology for field search teams opens up a new area of computer-aided search management. In this article, we discuss software developed as an aid to search management.

The background for this project is a chance meeting between one of its developers and members of the South Eastern Mountain Rescue Association (SEMRA).

John Ronan, one of the researchers in the project, has had an interest in amateur radio for many years. John is an active member of the Tipperary Amateur Radio Group, which often provided communications support to the yearly Galtee Mountain Walking Festival in the Glen of Aherlow. The other developer of the software, Kristian Walsh, is also a regular at the same festival. Also regulars at the event were members of SEMRA, and it was during a casual conversation between all of these people that the seeds of what became the GAISS project were sown.

What first impressed the SEMRA members was how John, operating a radio from a base at the foot of the mountains, was able to tell them exactly where each group was on the hill, without ever needing to call for a position report.

The secret was that there were several Amateur radio operators in each walk, and these people could be tracked remotely. For several years now, Amateur radio operators have been using a system called APRS ("Amateur Packet Reporting System") which allowed operators with suitably equipped radios to broadcast their position. In over a decade, APRS has grown to a worldwide network of thousands of stations, some mobile, and some stationary. With suitable software, or even by looking at special websites (www.aprs.fi) you can quickly find out where in the world a particular operator was last active, once you know their call-sign: a boon to long-suffering spouses of "mobile" station operators, maybe; but –more importantly– APRS is a fully functional tactical position and information reporting network.

Despite its many useful features, the APRS system has one major disadvantage from a mountain rescue perspective: the system is only accessible to licensed experimenters. Other disadvantages are that the radio equipment required is quite specialised, is not licensed to operate on the Mountain Rescue channels, and

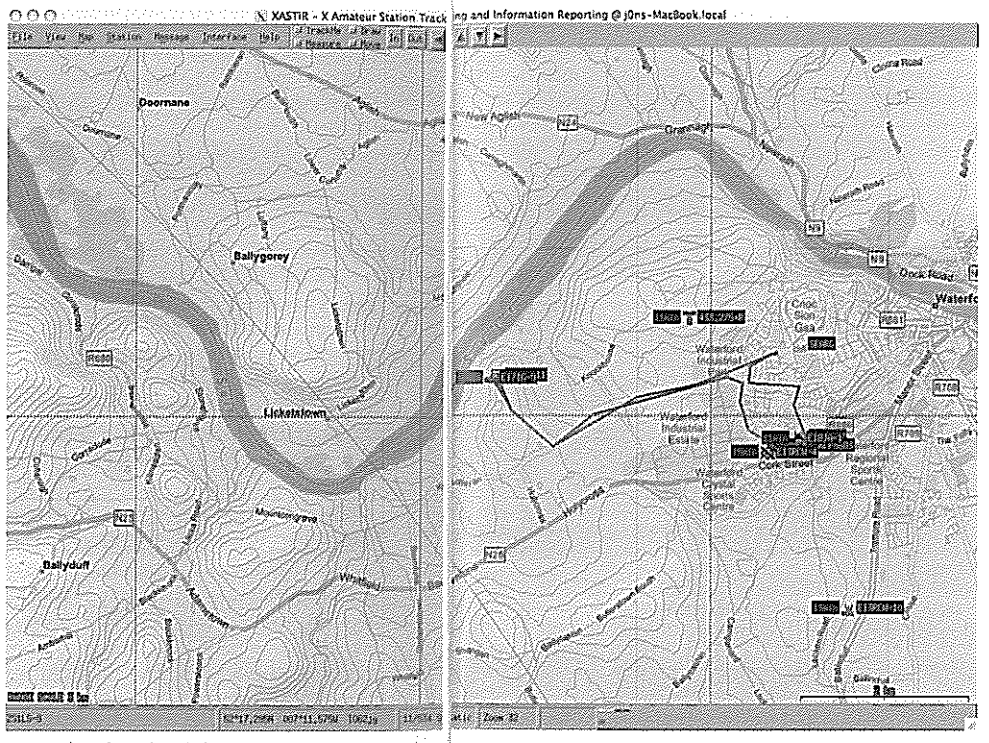


Figure 1 (main) & 2 (smaller): The XASTIR application (www.aprs.fi) showing John's position during trials

is not suitable for use in "safety of life" operations by untrained operators.

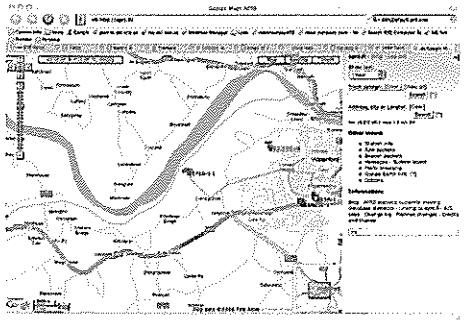
This is not to say that the amateur networks are completely unusable in emergency communications, though. The AREN group within the IRTS (the governing body for radio experimenters in Ireland) is a voluntary body of radio operators who are tasked with providing additional communications support and infrastructure in the event of a major emergency. In the event of the National Emergency Plan coming into effect, AREN can be called to situations where conventional communications are unavailable.

At the beginning of 2006, John Ronan and his colleagues in the TSSG Research Group in Waterford IT were exploring the problem of resource allocation for temporary operations: given a finite number of resources (for example, mobile internet access points), and a large area, how could you determine the best position for each resource.?

After mentioning this work to a member of SEMRA in response to a casual "What are you working on these days?" question, it quickly became obvious that a typical search operation can be described in exactly the same terms: how to allocate your limited resources (the search teams) over an area to achieve maximum effect (finding the missing person quickly).

TSSG made a proposal to Enterprise Ireland for funding to test the soundness of the "asset allocator" concept. It was decided to use Mountain Search operations as the test case, as this was a challenging environment where typical GSM or wireless internet based systems could not operate. The result was the GAISS project (Geographically Aware Information Support System).

The project aimed to provide two major benefits for the search manager: firstly, live



tracking of the units in the field, and secondly, a set of tools to assist in the allocation of teams to search areas. Of these two goals, the allocation system was the main task.

Live team tracking is a useful tactical tool. Incident commanders can find out their teams' approximate positions by looking at a map onscreen, instead of putting out a radio call for a position report. And as teams don't have to manually radio-in their positions, the voice radio channels are kept clear. In large operations, the burden of managing position reports from multiple teams is almost completely lifted from the radio officer.

However, live tracking is impossible if team members' radios can't report their positions. While the APRS equipment used by amateurs is capable of this, the feature was relatively rare on the type of radio equipment used by Mountain Rescue teams. Fortunately, just as funding became available to TSSG, IMRA secured new radio equipment for its' teams, and these new Simoco SRP-9000 radios had a GPS-based position reporting capability.

The Simoco radios have a longer operational history in the UK. The Duddon & Furness M.R. group has used these radios for some time, and Dave Binks of the same group has developed a live tracking program called MRMap (see Kenny Roberts' article on the next page. MRMap is currently used by some Irish M.R. groups already, and has been demonstrated at the 2007 I.M.R.A. AGM.

While the GAISS project provides some of the functions of MRMap, and looks similar, the main aim of the GAISS software was to aid in a different area: search modelling.

While team tracking was not the main function of the GAISS software, some small improvements were made to the tracking display. In particular, the way team tracks are drawn. For instance, it is not right to connect two received position reports by a straight line, as it gives the impression that someone took a path that they may not in fact have taken (see figures 1 and 2).

Live position reporting is undoubtedly a useful tool for the search manager, but the computer is capable of doing much more to help them do their job more effectively. One of the recent developments in Search Theory is the statistical modelling used by the UK-based Centre for Search Research (CSR).

Using statistics gathered from over 700 incidents in the UK and Ireland, this model gives the search manager a "good idea" of the most likely location of the missing person once they have been accurately categorised into one of around a dozen behavioural profiles ("Alzheimer's patient", "Hiker", "Despondent", "Child: 7-12yrs", etc).

The basic idea is that different types of missing person, have in the past behaved in a certain way, and given enough incidents, it is possible to mathematically model how that type of person may behave in this instance. As the number of recorded cases increases, the accuracy of the predictions should also improve.

That said, there will obviously be cases where a person will display behaviours different to what has previously occurred. This new information needs to be incorporated into the model in order to accurately reflect all recorded cases.

The GAISS software is able to create a Probability of Area (POA) map based on the missing person profile. This shows the areas where the software thinks the person is most likely to be found (see figures 3 and 4).

The intelligence in the GAISS software is that the POA predictions it makes are not static. As the search progresses, and teams are de-briefed, the software re-calculates the model to reflect the search results. For instance, if a team searched an area with a high level of confidence, the software will use this information (gleaned from the de-brief), and the actual track the team has taken (as recorded by their GPS equipment) to update the probability map for the scene: an area that has just been searched has a lower probability of containing the missing person than an un-searched area.

This allows the search manager to quickly see not just that an area was searched, but also, how confident the team leader was of their results, and also how long ago the search was (areas are considered to be less relevant to the statistical model the longer the search goes on).

At this point, it is necessary to talk about the deficiencies of this approach. First, and most important: this model is only useful if the missing person is correctly categorised and the Point Last Seen (PLS) is correct. As with any system, good outputs depend on good input. No software is ever going to replace a thorough search of the PLS. The software provides information - decision making still rests solely in human hands.

The second point is that the GAISS software is only one interpretation of how search area modelling could work. The software has been developed with considerable valuable input from SEMRA members and Dave Perkins from CSR, but it still remains in a very early stage of development.

Future Directions

This project was funded by Enterprise Ireland under their Proof of Concept programme, which aims to support academic researchers to explore concepts with commercial potential. The area we sought to explore was the algorithmic allocation of scarce resources over a large area to maximum effect. Mountain Rescue was chosen as a test-case because it illustrated a "worst-case" environment.

Unfortunately the project has now finished, and while the developers are still looking for an avenue for further research/work in the area, this has not been found as yet.

GAISS shows one direction in which computer-aided search management could go in future. With development, the system could provide a useful tool in the search manager's toolbox to help in planning of searches and location of teams.

Thanks to the SEMRA and SARDA personnel that gave valuable feedback during the project, Dave Binks for pointers early in the development process, Dave Perkins of the CSR for his considerable input, and Enterprise Ireland for funding the project under their Proof of Concept programme.

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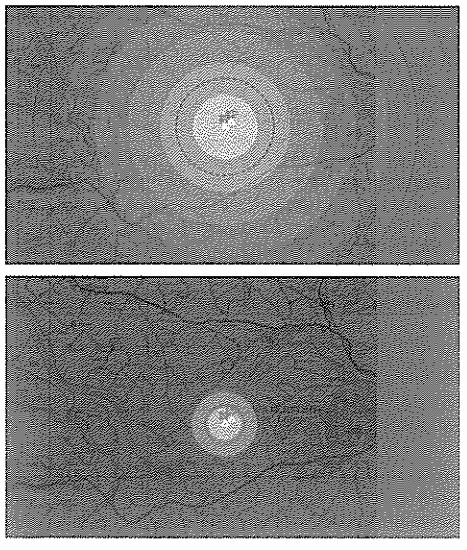

Figure 3 (top) and 4 (bottom): The capability of movement for an Alzheimers' patient (top) is wider than that of a young child (bottom). This is demonstrated in model by the 70% (top) and 30% (bottom) POA rings