TRAINING & TECHNOLOGY FOR SAFER AND MORE EFFECTIVE FOREST FIRE FIGHTING

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Abstract

This paper focuses on the need for specialised collaborative tools and effective training to better enable first responders to do their job more effectively and more safely. This paper addresses the need to provide situational awareness and real time monitoring and management for front line teams in disaster situations specifically to enable them to more effectively and more safely fight forest fires.

Intaero was founded in 1986 and has developed software for military and quasi military applications to exchange data in real time between operators in a mobile ad-hoc networked environment. Recently we have updated our command and control software to produce SMART (Situation Management and Awareness in Real Time) which shares data to provide command & control and situational awareness in the air and on the ground.

GeoSim is an established Australian company which has over 17 years of focused development and supply of high quality, cost-effective, fixed wing and simulation tools designed to meet specific training needs. They have produced in excess of 85 simulators and achieved over 57 CASA accreditations.

Our two companies have formed a Joint Venture to provide training and operational tools to enable disaster situations to be handled more effectively and to provide better safety for aircrew and first responders.

The paper will cover the following:

a. Command & Control: SMART is a real-time solution for exchanging data over low bandwidth links to support effective command & control and situational awareness to make forest fire-fighting safer and more effective.

b. Systems Integration: Integration of SMART with real time, airborne, Infra-Red videos and with fire spread prediction software.

c. Crew Training: Training pilots and crew members on helicopters and SEATs by day and night to support disaster management operations, including fire suppression and mission rehearsal

Keywords

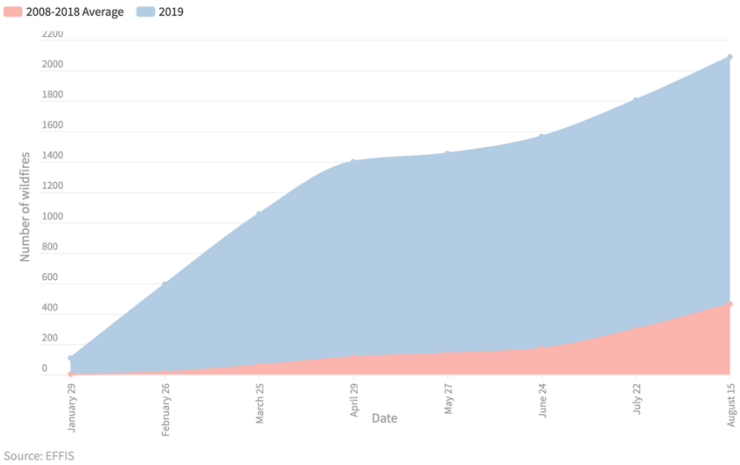
Tools to make fighting forest fires safer and more effective

Training ground teams and aircrew to support disasters

Introduction

The Growing Challenge of Wild-Fires

Europe is seeing a dramatic increase in the number of Forest fires. A report from the European Commission states that as the fire season becomes longer and climate change reduces fuel moisture levels from present values and that the Mediterranean region will become drier, increasing the weather-driven danger of forest fires. The report adds that areas exhibiting low moisture will extend further northwards from the Mediterranean than present.



Forest Fires in Germany

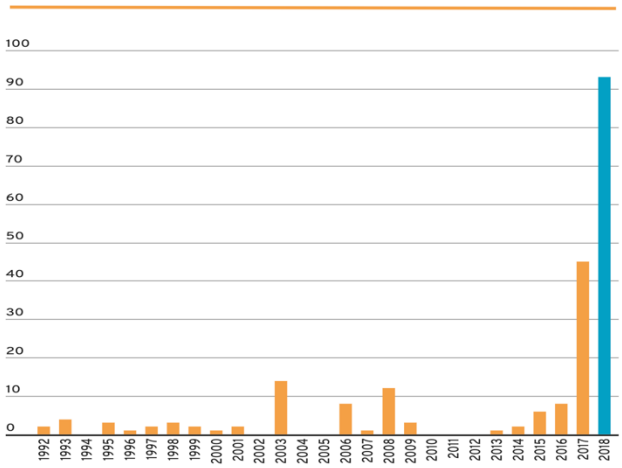
There were 1,708 forest fires in Germany in 2018 — more than four times as many as the previous year. This was the highest number of blazes recorded in the country since 2003.

A fire earlier this year in China resulted in the death of 34 fire fighters when the winds changed and they were trapped. They had no way to monitor the change or to warn the fire fighters in time.

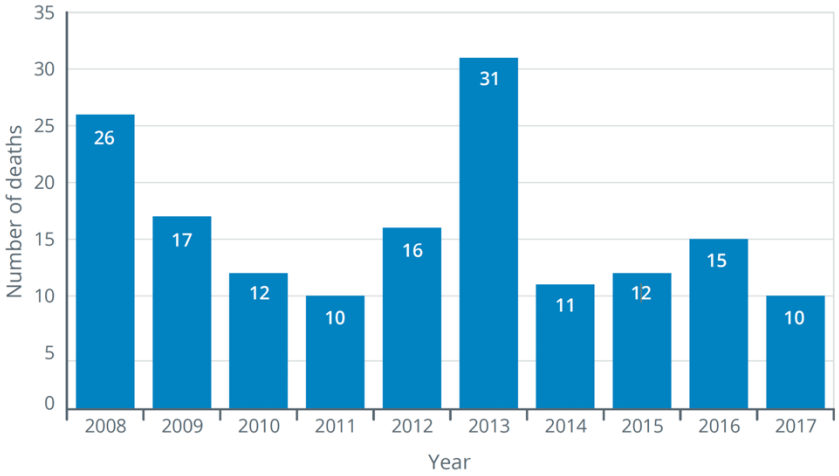
A warming climate complicates everything.

There is no longer a definable fire season in California. Hotter and drier seasons mean that big fires in California December, once almost unheard of, are now common. In earlier decades, fires late in the year might have sputtered out after hitting hillsides wet with winter rain. More recent blazes feasted on vegetation that has been sucked of moisture by persistent drought.

When 2018 became the worst fire year on record and a single fire in California at the end of the year which killed 85 people highlighted a number of issues. California recognized a new reality that each year could surpass the last, setting records for the size, destruction, cost, loss of homes and loss of life.



Overall Fire Deaths in California



Fire-Fighter Deaths in the US

Fighting Fires

Water is usually dropped directly on flames because its effect is short-lived. Fire retardants are typically dropped ahead of the moving fire or along its edge and may remain effective for two or more days. This can create artificial fire breaks where the terrain is too rugged or remote for ground crews to cut fire line.

Studies show that retardant is most effective in slowing fire growth in sparse vegetation on flat land in cool conditions, not so much at the peak of the afternoon under the blazing sun

Pilots in California are normally scheduled to begin flying no earlier than 10 a.m. and are barred from flying in darkness, so there are many fires they are unable to reach during the critical early moments. The report stated that the department had undermined its ability to combat fires by refusing to schedule aircraft during early morning hours and focusing instead on the hottest period of the day where high winds prevented aircraft from dropping effectively.

According to state fire data, half of the state's most destructive wildfires were ignited in darkness, or more than an hour before pilots were scheduled to begin operations.

Changing the way we fight forest fires

SMART (Situation Management and Awareness in Real Time)

The heritage of SMART is in technology designed specifically for use by the military in the field and under rugged, mobile conditions. Specifically, we have experience in the management of critical data over mobile, low bandwidth, ad hoc networks and the software was designed at the outset to work over any communication. All data and status from personnel in the field, aircraft, UAVs is generated using GPS based mobile devices and is integrated at the field commander's level in a single, graphical display which then transmits the complete situation to every mobile computer in the field and transmits all the data back to a regional or central command centre in real time using only a low bandwidth data link such as a commercial satellite provider.

All individual fire fighters can be supplied with small, rugged, GPS trackers, transmitting their location by GSM. SMART reads in their position, displays it and shares it on the network. SMART uses active zones which can be created manually or from a third-party software such as a fire spread prediction tool. They can be set up to give a warning when a person or vehicle (using GPS-based position in SMART) enters or leaves the zone.

SMART is able to input the georeferenced, streamed output, from an IR camera on a UAV or helicopter and extract the hot spots representing the fire line or individual fires. This can then be input to a fire spread prediction software.

Fire as seen through an IR Camera

SMART uses formatted messages to send data over a network. This is inherently light format and therefore only requires a very low bandwidth communication medium to be fully operational. SMART is communications agnostic. It can work over any network created, for example, by a GSM, Mesh radios, satellite communications or the internet. It can also work over any existing rugged tablet computer.

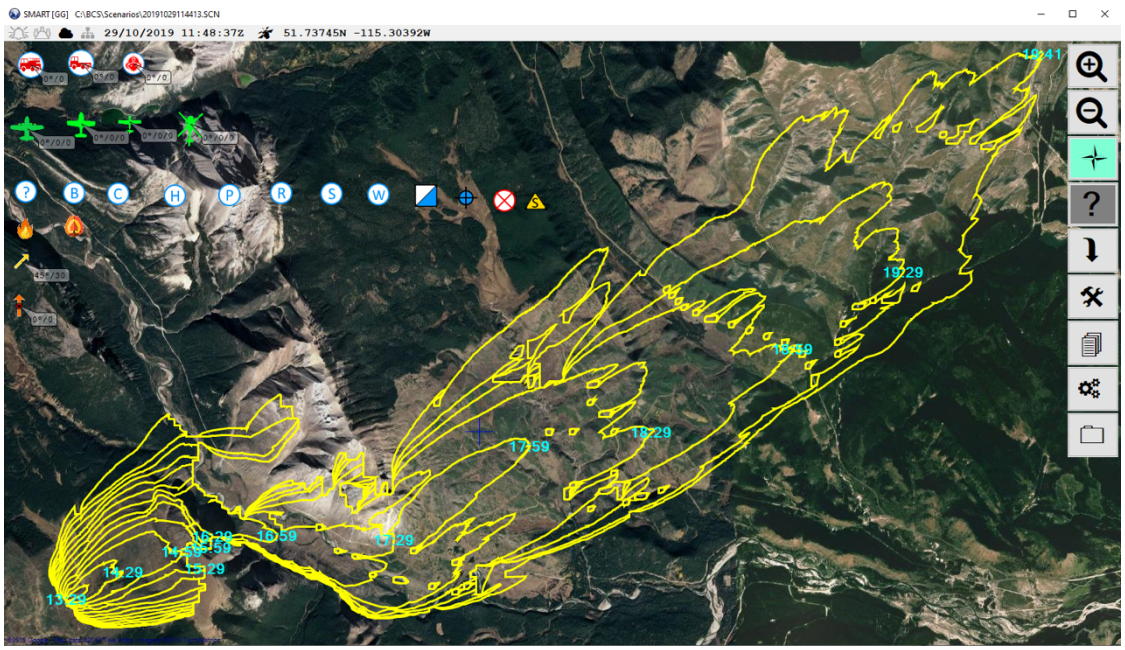
One benefit of SMART is that all users can share logistics and the status of assets in real time. For example, an operator contracted to supply airborne fire-fighting assets can update the status of the assets on a routine basis, thereby enabling the fire manager to see what aircraft he has available and the time it would take to activate those aircraft and get them on site. From the operators perspective, it enables them to see the situation unfolding and prepare their assets for a rapid response to the developing requirement.

There are 3 versions of the software for command posts, airborne and ground applications

SMART Server

SMART Server is a server-based application which is designed to run in a headquarters or command post with internet connectivity. It is a 3D application, accurately showing a selected map draped over terrain. We are working with partners Collins Aerospace to drape streaming video from their TASE Infrared sensors mounted on either a UAV or a helicopter. IR video sees through smoke and differentiates between burned areas in relationship to active areas which enables the operator to map the actual spread of the fire in SMART in real time as an active zone.

This active fire zone can then be input into the software to update the fire spread model which in turn can be brought back into SMART as time-based fire zone. SMART does not send images, rather it sends the zone as defined by three dimensional points which are distributed throughout the SMART network using formatted messages that only require a very low bandwidth for transmission.



Inputting a Fire Line prediction from Prometheus

By providing fire managers and commanders with critical information on the extent and spread of the fire we enable them to better fight forest fires thus saving wildlife, vegetation, homes, resources and lives.

SMART Ground

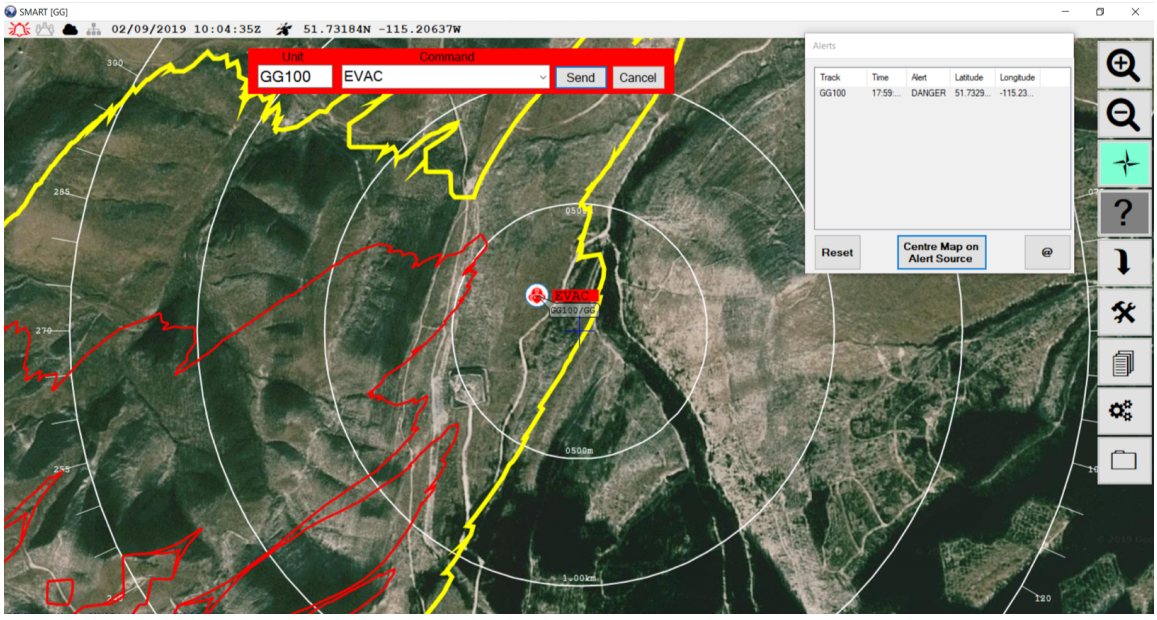
SMART Ground is a stand-alone application which the GUI is specifically designed for use in the field by operators who are not necessarily computer literate. Every vehicle and team leader can be equipped with a rugged computer with GPS, together with data communications including group chat or user to user chat.

Each unit transmits its position and status and received the current situation in their vicinity, commands and alerts. The preferred means of communication is a MESH radio environment which is easy to set up, has a good range between units and always available. Different radios are available for personal use, for fitting in a vehicle and for use at the situation commander's vehicle or post.

There is also the possibility to use 3G or 4G working in a private network which will operate without needing a backhaul link, with the GSM base station at the commander's vehicle or post. If GSM is deployed, small, rugged, GSM / GPS trackers can be attached to critical infrastructure and logistics to report their position and status on a routine basis. SMART can be adapted to use any language and is easy to update to reflect the specific requirements of any type of disaster

SMART Ground

In the image below we show the output of a fire spread prediction software being imported into SMART Ground and set up to report and alarm if anyone or any vehicle fitted with a GPS unit enters or is present in a dangerous zone. In this case an individual is show entering a yellow area which is predicted to be where the fire is heading. This alert is available to the situation commander and the individuals team leader as both an audio and visual alarm on SMART running on his tablet computer.

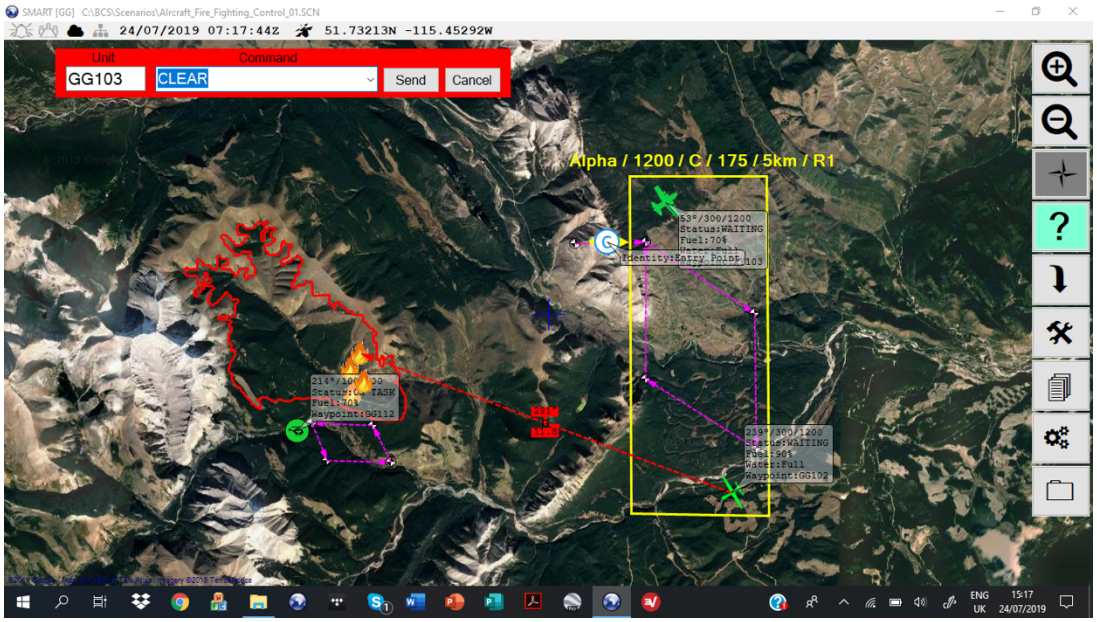


Warning, Alerting and Commanding

SMART Air

Airplanes and helicopters are integral to the management and suppression of wildfires, often operating in high-risk, low-altitude environments. These aircraft are used to deliver equipment and supplies, deploy and transport firefighters, conduct reconnaissance, scout and direct operations, and deliver fire retardant or water.

A version of SMART has been designed specifically for use on a tablet computer inside the cockpit of a helicopter, SEAT or heavy bomber aircraft. This is also a stand-alone application.



SMART Air

The tablet computer is interfaced to a small GPS / INU unit which can either be battery powered or connected to the aircraft power supply. This can be mounted on the windshield of the aircraft. It has an in-built GPS aerial and can also have an external GPS aerial to ensure good GPS reception regardless of the cockpit configuration. The tablet is also interfaced to a small radio which transmits and receives through a single, unidirectional antenna.

The displays are designed based on our unique operational experience to provide full situational awareness of the aircrafts position and information on all other aircraft, ground teams and vehicles in the vicinity running SMART to prevent accidental contact.

The display offers the pilot navigation support to navigate to a holding pattern and also to local water sources which can be used. SMART graphically shows the location and direction of the required retardant or water drop for each aircraft. Commands can be sent to the pilot either from a lead aircraft or the situation commander and these have to be acknowledged by the pilot to confirm receipt and understanding of the requirement.

Training for Helicopter and Fixed Wing support operations

We believe that all training should be conducted as crews, since crew cooperation is essential for safe and effective fire-fighting. Intaero has developed a series of focused training programs to train crews specifically for supporting disasters including earthquake, floods and fighting forest fires

We are not training aircrew to fly a specific aircraft or helicopter type but rather to gain experience of the techniques and crew co-operation to operate the aircraft safely in an often chaotic and dangerous air environment. We are using a simulator built by Geosim based on the Bell 412 EPI which is ideal for training pilots and observers for supporting disaster management teams, both by day and by night.

The simulator has physical switches and representative displays and systems so that the pilots are able to go through all normal and emergency procedures including electrical failures, engine failure etc. while flying with an underslung load, hovering during winching operations or using NGVs.

The simulator has a unique configuration to train crew co-operation, a critical element in the safe operation of a helicopter. Behind the pilots is a platform for a crew member and a physical hoist mechanism with a cable that runs around the simulator. The simulator visuals combine a three-projector dome for the pilots and a Virtual Reality Headset for the rear crew. They both have the same view, but the VR headset allows the rear crew member to look "outside, to the rear and below" the helicopter. He can therefore guide the pilots to a survivor and keep the pilots in an accurate hover while lowering a "crew member" with a stretcher to pick up the survivor.

View through a VR Headset

The training also includes flying with an underslung load such as a Bambi Bucket. Again, this requires close co-operation between the crew member and the pilots and the ability of the crew to see below the helicopter and to advise on the behaviour of the load / Bambi Bucket makes our training uniquely valuable and cost effective

GeoSim has also developed and constructed an Air Tractor 802 simulation device which links with other simulators and also with SMART to input real time situational data. This enables the simulation to be used for mission rehearsal, an application already in place with one customer.

Realistic fire -fighting simulation

This ability to link remote simulators to run the same scenario at the same time and see all the other players will enable the training to be extended to enhance performance in other emergency operations like EMS and SAR.

Training for Air Support at night

We believe that air support for disasters should be available on a 24/7 basis and not just during daylight hours. This involves some very specific training in the use of Night Vision Goggles (NVGs).

In many ways the conditions at night-time are ideal for firefighting: reduced temperatures, increased humidity and often lighter winds cause fires to 'stand down', providing a window of opportunity for crews on the ground. Surprisingly, though, very little night-time firefighting takes place, with the advantages of more favourable conditions often outweighed by concerns over poor visibility and, consequently, an increased risk of collision.

Current night-time training often uses models lit by low level lights, with pilots walking around them wearing NVGs. This lack of realism hinders effective night-time operational training and is of little practical value when using NVGs in a real-world situation. Effective night-time training for helicopters being used in disaster management situations requires the simulation of the illusions and limitations experienced while wearing Night Vision Goggles while flying representative operational sorties at night.

View through Night Vision Goggles

Night vision goggles (NVGs) are designed to provide the pilot with some of the visual cues they lose at night. NVGs are not simple-to-operate devices that pilots can just pick up and use. They need specialized training. When pilots are properly trained in the use of NVGs and use NVGs properly, they can better manage aircraft systems and operational missions during night operations. Pilot workload initially increases when using NVGs and pilots must learn a new set of skills to use NVGs properly and take advantage of the benefits.

There are a number of missions and operational tasks which are difficult during daytime and which become very challenging when operating at night. These include:

- Nap of the earth flight at night
- Personnel Search and Rescue
- Operations from remote landing sites

- Hovering and winching
- Water bombing at night
- Handling aircraft normal procedures
- Handling aircraft emergency procedures

We have developed a unique, 3-stage training program, specifically to meet these requirements:

Phase 1: Computer Based Training to provide pilots and flight crews a detailed grounding in human physiology and pre and post flight NVG handling.

Phase 2: Using NVGS in a simulator. This phase re-enforces learning with NVG experience in a purpose designed, generic NVG Simulator under the supervision of an NVG qualified instructor pilot. We teach proper piloting techniques when using NVGs during all phases of flight, carriage of underslung loads at night and operational flying in support of disaster situations including firefighting

Phase 3: Operational training with NVGs in company aircraft:

Conclusion

Climate change is increasing the risk and intensity of forest fires

Fire-fighting whether by air or on the ground is dangerous and no systems will remove all the risks.

Aerial firefighting is most effectively used in conjunction with ground-based efforts, as aircraft are only one weapon in the firefighting arsenal.

Training pilots and crew members how to operate safely and effectively in all disaster support situations and particularly to fight fires by day and night will make the use of expensive resources more effective and safer.

The more real time information that is made available to the commander the better will be his decisions and the sooner he will be able to evacuate people in the path of the fire.

Situational awareness for all fire fighters will make the environment safer

Situational awareness for airborne crew will result in more effective use of airborne assets as well as ensuring that when they do make a drop, it is accurately and correctly positioned

By giving team leaders and other critical personnel on the ground access to all the relevant information in an easy to use, graphical format, they can act more effectively and better ensure their own safety.