Autonomy - Uncrewed - Drone.

Introduction

Igence has been involved in the Autonomy arena since 2006 when retained to participate in a UAV sense and avoid research project. Over the years the terminology has changed - Autonomous to Unmanned to Uncrewed and the catch all use of Drone to describe various vehicles / vessels across the Air, Sea and Land domains.

Definitions

- *Autonomous - independent and having the power to make your own decisions.*

  Originally from the Greek definition - existing as an independent entity.

- *Drone - a remote-controlled or autonomous pilotless vehicle.*

Igence Experience

Discussions will continue for some time about autonomous capability, the human in the loop, remote control, safety concerns etc. However, the ongoing work and challenges over the last 10 years or so have produced a better understanding and definition of the complexities involved.

Igence has been predominantly involved in autonomy projects in the Defence Aerospace and Maritime domains. All domains have a mixture of similar and unique challenges but also common operational and safety requirements, whether AUV (autonomous underwater vehicles), UAV (uncrewed aerial vehicle) or USV (uncrewed surface vehicle), or derivatives.

Defence demands have required the development of Command and Control Systems (Ship, Shore or Mobile Unit based), or Ground Stations, where integration of the various sub-systems signals (e.g. sound, camera, radar, sonar, weapon systems, hazard analysis, VMS (vessel management systems),etc. are all required at a single point of control. The Human in the Loop is then able to observe, react, update, amend or intercede as operational requirements demand.

Challenges

Monitoring and managing potentially hazardous environments requires a comprehensive Geographic Information Systems (GIS): using selected mapping systems and appropriate data to provide situational information for operators to make informed decisions. Invariably this requires one or more of the following capabilities-

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- *Destination and way-point capability:* with ability to react to required/preferred changes. This information needs to be married with Radar (when appropriate), Sonar, Machine Vision and depth sensors to ensure the UUV/USV can navigate safely and provide operator feedback. The data received usually forms a part of the input to Sense & Avoid.
- *Mapping Sense & Avoid requirements:* Very much depending on the domain, this may require real-time or near-real time analysis of map features to identify hazards. In the Maritime domain this will involve depth areas and known hazards such as buoys, wrecks, land, sub-merged rocks, bridges,

restricted areas etc, extracted from S-63 (encrypted), or S-57 (unencrypted). Currently these map features and particularly hazards come in different map formats depending on the source. The map features are often encoded differently (e.g. names, units). Mapping the features and attributes to a single definition simplifies the analysis software. The rules for analysing hazards will normally still be domain specific. Spatial analysis will likely be the same. (inside, outside, touching, crossing).


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- *Mapping data analysis and visualisation:* Display of radar, sonar, video, track information, environment (tide, weather etc.), restrictions and known / identified hazards to enable remote command and control capability requires the 'integration' of all the signal inputs. Whether in numerical, text, video or other form, analysis enables responses or actions based on the real-time incoming data.
- *Identification and processing of additional map data*: for increased situational awareness such as Open Street Map, Bathymetry etc.
- *Signalling bandwidth:* All of the above may require sizable volumes of data that must pass through often limited bandwidth, depending on the environment / location.
- *Future Requirements:* As multi-domain co-ordinated activities are discussed there will be a requirement to begin to standardise where possible the various operational and control systems currently used. This will be challenging for technical, domain restrictions / regulations, equipment capability and ownership issues.

Autonomy Team

Igence has a dedicated autonomy team that continues to meet the challenges by relying on their considerable experience, systems, software and mathematical skills to develop solutions and keep pace with the increasing requirements and changing technologies across the various domains.

We are now seeing more demand for the solutions and skills learned in the defence sector crossing over into the public domain demands.

Igence Autonomy Projects

2006 - Research into UAV sense and avoid requirements for a UK Defence prime.

2009 - A project with a major defence prime contractor on an ISTAR drone- development of emulation and testing sequences.

2010 - Development of a training environment for a UAV for a UK Defence prime contractor.

2017 - 2022 - retained as part of the design / prototype / development of the BAE Systems P950 - P24 / Navy X USV program. The P24 has now passed live firing testing and also achieved Lloyds Register Unmanned Marine Systems Certification. (See our P24 Case Study).

2021 - present- Part of the development team for a 'mine hunter' UUV for a Defence prime contractor.

2022 - present- Part of the development team for the BAE Systems NAUTOMATE program (USV).

2023 - present- Part of the development team for an BAE Systems Herne program (XLAUV).

Certificate Number 4084

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