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Future Capabilities Team – Robotic Platoon Vehicles

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THE IMPORTANCE OF HUMAN ROBOT INTERACTION

References:

- A. A
- B. B.

Issue

1. There are reported instances of Semi and Fully Autonomous Capabilities not being utilised for the full capability available. This is due to a lack of trust in these machine guided capability resulting in an inefficient use of the systems themselves. A lack of awareness or understanding of Human Robot Interaction means that this issue is not being addressed as effectively as it could. Building on this will enhance the capabilities that already exist and pave the way for more advanced higher autonomous capabilities in future.

Recommendations

- 2. Develop RPV User Awareness Training
- 3. In Barracks Use of RPs
- 4. Develop and Maintain a Robotics and Autonomous Systems Community of Interest
- 5. Make sure Industry is aware of HRI knowledge during development of systems

Timings

- 6. As some Vehicles are already with Users, RUAT development should be the priority.
- 7. The creation and development of the RAS Col is currently taking place and will be formally organised within 12 months.

Background

8. More and more autonomous systems are now emerging from industry. Along with the greater availability these systems are growing significantly in capability. As these capabilities grow we need to be in a position to harness these effectively for use in theatre and or alongside our troops during their duties on base. As this sector gains momentum, new areas of study accompany it. Human Robot Interaction is a broad multidisciplinary research field that we need to embrace both in design and development of new systems and within our policy and doctrine. If done correctly it will only enhance the benefits of autonomous systems, including augmentation of soldiers'

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capabilities, risk reduction to human life in hostile environments and a way to offset physical and mental loads of soldiers in the field.

Capabilities

9. RPV

a. **Manual & Tele Operation** Manual and teleoperation of equipment is not a brand new field of technology. However as a baseline for technical and operational capability it is imperative to use the existing knowledge to create a strong foundation. This foundation can both augment and secure emerging technologies. The use of a controller operated over Bluetooth, WiFi, or Independent Radios forms the base of this capability. Normally the use of a joystick to direct the vehicle along with an ability to change modes of speed form a basis. A larger controller on a more complicated machine can also allow the use of teleoperation through cameras situated on the vehicle itself. The RPVs that are currently being trialled all have these capabilities to varying levels of ability. There is the future opportunity to also have further operational capabilities in the form of directed weaponry, robotic arms and other actuators allowing the user to interact with the robot's environment from a distance. All of these provide the operator a decreased risk through distance from a hostile environment.

b. **Autonomous Modes** During FCT's RPV trials two separate modes of autonomy have been trialled. These are the "Follow Me" and "Go To" autonomous modes. Both allow for a lower cognitive strain on the user whilst in operation.

(1) The "Follow Me" mode sets the RPV to follow a user at a set distance. Depending on the vehicle this set distance can be measured in a number of ways from computer imaging through cameras to Bluetooth clips. It is designed that the user may have the vehicle follow them during operation such that it is ready as and when it is needed. It can also carry a load to augment the users capabilities and reduce the physical burden of carrying it themselves; whilst on "Follow Me" mode the cognitive burden is reduced as much as possible as well. This mode can incorporate other autonomous capabilities such as obstacle avoidance, such that it can follow users through complicated terrain such as forests.

(2) The "Go To" mode allows the users to dictate the journey of the vehicle from point A, often it's current location, to point B on a map. The Vehicle then drives itself to the end point. This capability can include a control on the speed of the vehicle, routes taken, a number points that the vehicle must go via and what type of terrain or track it should take preference on whilst travelling. During it's travel the cameras on the vehicle are operational and the user can see what it "sees".

c. **Operational Capabilities** With the current capabilities the RPVs are looking to undertake a range of operational capabilities.

(1) Medevac/Casevac, the RPVs are envisioned to be able to carry 1 or 2 wounded personnel on stretchers to safety. This could be done whilst in "Follow Me" mode or even "Go To" mode at higher speeds than the unit could normally move their wounded to a safe position or hospital.

(2) Reconnaissance, by their very nature the RPVs have a large number of sensors for the autonomous modes. These sensors could easily be used to recon hostile environments or ahead of users. The use of electric engines in a number of the RPVs also mean that they are quiet for the amount of equipment that they are moving across land.

(3) Logistics, the carrying capacity of these vehicles is at least half a ton upwards. This load carrying capability could be used to carry standard bergens, extra ammo,

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rations or water or even other systems like heavy weapons or drones. Thanks to the autonomous modes, this logistics capability can be used pre-emptively, by following users, or reactively, by being sent to users when they require something. They could also be used more conventionally to move loads around base for convenience.

The importance of Human Robot Interaction

10. **Capitalizing on existing capabilities** Due to a number of human factors, RAS equipment is often not being used as effectively or efficiently as it could be. These factors include, mistrust, misunderstanding, unfamiliarity, personification, complacency and over-trust. All of these can be eliminated or mitigated through the use of Human Robot Interaction. For instance users may not use equipment within its technical and operational capability due to a lack of trust that the equipment will perform the mission correctly or at all. This is a dangerous lack of use of existing capabilities as often RAS systems are developed with the aim of being used in hostile environment to lower the risk to the users. Another example is use of the robot in disregard to its constraints, causing damage to the robot, other equipment or even harm to personnel. This complacency or over-trust can be combatted with HRI to maintain capability without damage.

11. **Development of future capabilities** Because HRI is a developing field there is an opportunity to gain valuable insight through the application of HRI processes. This insight can be then built on to enhance our ability to use HRI on other projects and to guide development of RAS capabilities in future. Not only is it a way to enhance our current capabilities, but it is an investment to add value in future.

12. **Safety** As noted on above, safety is a key aspect of HRI. Making sure that the users are interacting with the robots in the designed, correct and safe manner will make sure that no damage will come to equipment or personnel or put equipment or personnel in a dangerous environment that they do not need to be in.

How to implement Human Robot Interaction

13. **Intuitive Design** Starting with the Concept and Design steps in the procurement process we can start building in Intuitive Design and implement Human Robot Interaction know how to create Robots that users can operate with less training and a higher level of trust through a basic foundation of knowledge. This basic foundation of knowledge is the same concept that we already use in General Vehicle Architecture. With this intuitive design built in, the user will already have a sense of familiarity with the equipment, eliminating some of the operational use hours to build this familiarity.

14. **Manage Expectations** It has been shown that when a robot has no particular use, negative feelings are often expressed. This is due to the user not having a correct level of understanding regarding the capabilities, use or constraints of the equipment in mention. It is important that emphasis is put on both the capability enhance that the equipment can bring, but also how the human and the machine are paired. Cooperation and collaboration between human and machine is vital. There still exist many things which a human can do that the robots cannot. The systems are not fool proof and may do things that are not expected. Users must be aware that they, the humans, are still a vital link the chain which if removed, removes much, if not all, of the robots capability. The enhancements the robots can bring to augment the capabilities of the unit they are attached to should also be clearly defined, or if there is a level of experimentation attached to the ownership of the robots at this beginning stage, that should also made clear so the users will accept these constraints and communicate feedback clearly on where the robot is performing or underperforming and insight on the uses the robots could have.

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15. **Demonstrate Capabilities** Films and demonstrations presented during training is a key element to providing understanding of the capabilities and constraints of the equipment to the users clearly. This is a strong opportunity to deliver key messages and a brilliant way to manage expectations from an early time in the users journey with the RPVs. It should be demonstrated what the can and cannot do, how the system augments human capability including load carriage and risk reduction and exactly how the users attain these capabilities through their part in the robot and human relationship.

16. **Build Familiarity** With the understanding from the training, the last step to building trust is to encourage the growth of familiarity. Allowing the users to operate the vehicles on training and experimental missions as well as in and around their base for small tasks or personal training of the operation, will start to foster familiarity with the equipment and thus build trust. Not only would this build familiarity but it would also give the users time to get acquainted with robots capabilities and constraints, as well as feedback any questions, misunderstandings or ideas for the betterment of design in future projects or spirals.

Other important notes

17. It is important to note.

a. **New area of research.** Whilst the area of Human Robotic Interactions has a large presence in the emerging technology world and has roots in a multitude of engineering and psychological disciplines, it is also a new field. Because of this the knowledge and best practices are still being developed and created by innovators. There is definite value in keeping up to date with the current knowledge base on the subject and an opportunity to have personnel help develop and guide this research.

Constraints

18. Whilst there are considerable advantages to being aware and utilising HRI, there are some potential issues which are outlined below.

a. **Over-trust.** There is a risk of building too much trust within the operators and peripheral personnel in the machines that can lead to an underuse or reluctance to use Emergency Stops and follow safety procedure. This could lead to issues around the casual use of the vehicles and accidents may occur as a result.

b. **Communication of data.** Once data has been captured by the RPV during its mission, communications constraints may be encountered. Personnel may be a situated a considerable distance from the operating environment.

c. **Security.** The provenance of the equipment used to perform the surveys must be taken into consideration when procuring systems for these tasks, as their components may have been compromised in the supply chain. Should the systems be compromised then data on the layouts of camps, or proposed locations of camps, could be exploited by an enemy.

d. **Dependence and Complacency** A risk that must be considered is that building a level of trust and confidence in a system may lead to dependence on that capability within human teams. Complacency in standards and awareness of dependency on these capabilities must also be guarded against.

e. **Personification.** Human Robot Interaction also delves into the social psychology of people. It has been shown that Robots can illicit social emotions amongst people given the right factors. It has been shown that people will attribute personality characteristics in equipment that is not actually implemented by software. Personification should be avoided

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where possible such that the equipment is not impeded in its capabilities due to human judgement on decisions such as mission parameters.

Opportunities for Exploitation

19. There already exist avenues of opportunity within reach that would enable practical investigations into the utility of Human Robot Interaction. These opportunities are presented below.

a. **RPV** The Robotic Platoon Vehicle project run by the Future Capabilities Team is an existing avenue of opportunity that HRI can both be implemented to gain instant value but an area where practical investigations of the use of HRI can be conducted with guaranteed feedback from industry, DES and users. It is fairly experimental allowing for a clear implementation of HRI and its analysis during operation. The team itself should also be open to shifting resources to develop HRI in accordance to their project with an eye on implementing on it's many other RAS projects.

b. **R&AS Col.** The Robotics and Autonomous Systems Community of Interest is a golden opportunity for the use of HRI to be discussed, debated, developed and studied by a range of developers, workers and users, from pre concept projects through to projects that are currently being used in theatre. This dissemination and dissection of knowledge by a large number of SQEP personnel is a fantastic resource. Because it is in it's infancy and still being set up there is an opportunity for invested parties to help guide it's development, including the notation of the importance of HRI within DES and project users.

Recommendations

20. From the discussions presented above, a number of recommendations can be generated.

a. Develop the RPV User Awareness Training. Training already being created by the FCT team in the form of a User Awareness Training scheme should continue to be developed with Human Robot Interaction in mind to have the greatest impact on Users of the Robotic Platoon Vehicle. This should tie in managing expectations, demonstrating capabilities and lead on to the building of familiarity. Consideration needs to be put into the format of this message and the delivery of the message to the Users as this is a experimental emerging technology and the capabilities and boundaries are fluid on the differing systems and in some cases on the same developing system.

b. In Barracks Use of RPVs should commence as soon as the RUA Training has been undertaken by the users. Whilst the training is still fresh in their minds, the RPVs should be taken out and trialled and used to help with menial tasks such as moving loads around base. Precautions should be taken as per usual with heavy equipment with someone always in line of sight of the vehicle and to drive under the speed limit, and at minimal speeds whilst inside hangars or in close quarters with personnel or other equipment, vehicles or buildings. Not only will this build familiarisation within the users but should also produce invaluable insight and generate actionable feedback from the users in regards to manual operation and operational capability and uses. All of this should be recorded and gathered by the FCT.

c. The Robotics and Autonomous Systems Community of Interest should continue to be developed, owned initially by the FCT, with regular meetings and defined objectives. This Col should develop an open area in which teams with similar problems can share solutions and insight with one another to progress and enhance their individual projects, all whilst giving feedback regarding the implementation of said solutions. Another fantastic opportunity is a Question Roster, focusing on the questions both actionable and theoretical that the Community as a whole are already facing or may face in future. This roster can be managed

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by those running the Col and a regular meeting should occur to discuss answers and close questions. This is an incredible opportunity to not only to create a community that will help keep pace with the fast emerging world of RAS but also a significant opportunity to shape the culture, working practices and direction that RAS takes within Defence.

d. An effort should be made to have a working knowledge of HRI within the DES and User teams that will be participating in RAS within defence such that we, the customer, can help guide industry to develop and create intuitive design models for future RAS equipment.

e. Creating Film to demonstrate capabilities during training with ease. These Films should be created by the FCT especially the RPV project. Created with the purpose to demonstrate the capabilities of the vehicles in an operational environment, these films would be an easy yet efficient way to kickstart the understanding of the RPVs during the RUAT and over general training.

(Original signed)

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