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Title: Enhanced dialog for Human-Autonomy Teaming – A breakthrough approach

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1. SUMMARY

Considering the ever-growing and deeper interaction between humans and intelligent systems, it is clear that efforts need to be made to ensure a less demanding *cognitive workload* for the operator. The key to this is bringing the focus onto the human relationship with machines, ensuring that this interaction is as effective as possible.

Any difficulty in understanding at this point can have significant repercussions. Thus, our approach named COMBI is able to take communication between humans and *Embedded Decision Aid Systems*, which can be incredibly complex, and make it mutually intelligible. This means:

- Ensuring machines receive in a suitable language the operational intention of the human user
- Clarifying the proposals from the system in a way that can be easily utilized by humans

In creating a shared and mutually understandable cognitive representation, COMBI contributes to bridging that ontological gap between the high-level abstraction employed by humans and that low-level abstraction employed by machines.

2. CONTEXT AND RELEVANCE OF OUR APPROACH

In light of the fact that intelligent systems are gaining greater autonomy and complexity there is an inevitable need for more in depth training of operators to fully master Embedded Decision Aid Systems.

Moreover, the increasing functional complexity of such embedded systems will come on top of already stressful and complex operational environments that potentially lead to cognitive overload for operators. To ease the workload of the human being, the collaboration process between humans and intelligent machines (virtual co-pilot, virtual assistant or other) will have to be more efficient.

These new technologies and algorithms in Artificial intelligence will have to be designed to assist the operators in their choices, as well as task planning and execution. However, the initial assessment is that this new reasoning and computing will not necessarily be easier to anticipate just as it is already complicated to do in those existing automations present on board aircraft and on the ground.

The future of avionics military and/or commercial operations are expected to become even more complex. A similar mission to one carried out today will include several intelligent systems that help reducing the number of operators (Single Pilot Operation, Single Pilot in Cruise, etc.). A more complex environment will not only increase the operator's workload but further distance them from the vital decision-making process.

Genuine collaborative work (from a human point of view) between humans and intelligent systems will be a game changer for future operations whatever the environment: ground, sea, sky or space.

Operations environment becoming more and more complex and uncertain, will have to enable operators to take on the role of "mission commander", sometimes in an improvised way, for a limited time

and for a specific unexpected mission (route modification in case of turbulence for example). In order to reduce the risk of cognitive overload, human operators should therefore be assisted:

- In the control of the systems,
- In collecting information from accessible resources,
- In building a collective "global view" to perform a mission.

Classically, this distribution of roles between human and the artificial agent is called "authority sharing". It is limited to the analysis of the tasks to be performed (task analysis) and to the development of related autonomous functions. The operator is then responsible for adapting this assistance, to meet the technical parameters for carrying out the mission. However, authority sharing is not enough to tackle complex future missions. The collaboration level between human and artificial agents should be increased and it is the objective of the Human-Autonomy Teaming concept.

To be efficient, the operator should not have to understand the details of "how" the system works, but should focus his attention on the mission and the strategic intentions he wants the system to put into action.

Human Autonomy Teaming (HAT) facilitates via a dialogue at a high level of abstraction (operator intentions)
One of the most important characteristics of HAT is efficient dialogue between participants. This is the way to establish a shared representation of the situation to improve decision-making. However, how dialogue is performed depends on the situation. To reduce the cognitive workload of managing complex systems, the communication level must be done at a high level of abstraction (see "operational intentions" bellow).

In fact, high-level intentions frame an operator's decision-making. These "intentions" in defense operations have not yet been translated directly into technical automated functions. Operators implicitly follow these intentions when they decide on the specific settings for each of the functions they will use like: mission planning, avoidance of threats (collision), adopted speed, cohesion of trajectories, etc..

Nowadays, human operators have to deal with fine-tuning newly created intelligent systems. To avoid that, Thales' proposition is to use a "Bidirectional Communicator" named COMBI (for "COMmunication BIdirectionnelle in French) between humans and intelligent systems to facilitate their dialogue.

The ultimate goal is to reposition the operator as a strategic & tactical decision-maker and not as an engineer as happens today. COMBI allow to determine the best mission / flight parameters that serve the operator high level intention taking account the current mission/flight conditions. Intelligent systems will be able to offer the best compromise for the technical computed solution presented at the same semantic level as the human intention, without forcing the operator to adapt from a technical expert point of view. This approach participates also in improving the explainability of AI problems

3. BIBLIOGRAPHY

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4. *KEYWORDS*:

Human Autonomy Teaming, Pilot Intentions,
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