Simulation-driven Automatic Textual Report Generation for Staff Training

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ABSTRACT

This paper describes the report generation concept, a service that automatically produces textual reports from events in an environment of simulation systems. The report generation is based on information from the simulation systems, but is independent of what specific systems are used. A prototype has been tested in command post exercises and deemed useful. The reports are intended to alleviate the work of the exercise support personnel. A number of technical challenges as well as user needs are noted.

1.0 INFORMATION NEEDS IN STAFF TRAINING

Military decision making is dependent on obtaining the right information in the right time. Training of commanders and staffs is to a large extent training the process of gathering the information needed and making judgements and decisions provided the information at hand. An environment for staff training must therefore supply an information context that is similar to what is to be expected in the foreseen mission.

1.1 Motivation and Introduction to Command Post Exercises

At the Swedish Armed Forces' Joint Training Centre, command post exercises (CPXs) are used to train commanders and staffs, predominantly at brigade level or above. Constraints on cost and availability of personnel pushes for minimization of staffing in the exercise organisation. This personnel is responsible for, among other things, acting subordinated staffs as well as higher command to the trained staff. The personnel is divided into response cells, where one cell could correspond to one subordinated staff, each cell consisting of a handful of people. The response cell tasks include performing and roleplaying every staff function, both in terms of planning and execution of military activities and creating the human to human interaction with the trained personnel, and as such create a realistic training environment. The response cell must also adjust their input to the trained staff so that exercise goals and training objectives are met and the training effect is maximized. This calls for a deep military competency, but in addition to this the RC personnel must interaction with a number of technical support systems. These competency requirements, paired with the high workload of the small number of people, makes it a great challenge to supply the right information to the trained staff, both in terms of quality of the information provided and the amount of reports or other products produced. Ultimately this might lead to negative training and unmet training objectives.
Several federated (interconnected) simulation systems are used to stage the conflict on the ground, in the air and at sea. Possibly several simulator operators effectuates the RC plans into the different simulation systems, and report back the result to the military staff at the RC. The RC staff has to judge whether the events and outcomes in the simulation systems is of significance to the trained staff, and if so when and how to deliver the information, for example by drafting and sending a report. The information delivered to the training audience (the trained staff) must also be aligned with the exercise game plan.

1.1.1 Exercise Environment and Development

The information environment in the exercise organization consist of mainly the following components, the command and control (C2) systems used by the training audience, possibly separate information systems

used exclusively by the exercise staff, the simulation systems driving the game, and exercise control systems that are used to coordinate the gaming and collect training evaluation information. To increase effectiveness and efficiency of the training at the Joint Training Centre, both methods and technical support is constantly developed. As such it is envisioned that the exercise staff shall be used for qualified human tasks such as human interaction and judgement, whereas computer systems shall be employed for labour tasks and any tasks possible to automate. To increase training systems effectiveness, flexibility and maintainability, solutions where small components are selected to interact and together provide a modelling and simulation system solution tailored for a specific exercise is foreseen, in accordance with the Modelling and Simulation as a Service (MSaaS) [1].

2.0 CONCEPT FOR AUTOMATIC TEXTUAL REPORT GENERATION

Influenced by the research field of computational creativity and a workshop on creative Twitter bots, an idea of a creative report generator sprung up.[2] The idea is to use information from the simulation systems and possibly other information sources, and draft textual reports of the quantity and with the quality expected from a military staff. Quality refers both to relevance of the information in the report and the expressiveness of the written text. This idea was developed into a concept of an automatic textual report generation system based on information from a network of interconnected simulation systems using HLA [4]. A prototype has iteratively been developed and tested to prove the validity of the concept, to collect user requirements and to identify technical challenges and requirements. The testing has been performed by a series of tests and evaluations in CPXs at the Joint Training Centre.

3.0 REPORT GENERATION

Events in the simulation systems trigger the automatic generation of a textual report. In particular, the use case of intelligence reports pertaining to observations of enemy units is employed. An aggregate level simulation system is used to handle land warfare. When the sensor of one unit in the simulation system spots another (hostile) unit, apart from what happens inside the simulation system, an HLA message is published on the simulation federation. The report generator is connected to the HLA federation and is triggered by this message. A report generator-internal history log of reported interaction is used to judge whether this observation is not relevant to report, is relevant to report immediately or to be stored for inclusion in a later report. If it is to be reported, the process of generating a message is initiated. The intelligence reports produced are comprised of three main elements, a description of the observation, a comment section and an assessment. See figure 3-1 for a schematic overview of the report generator process of work.

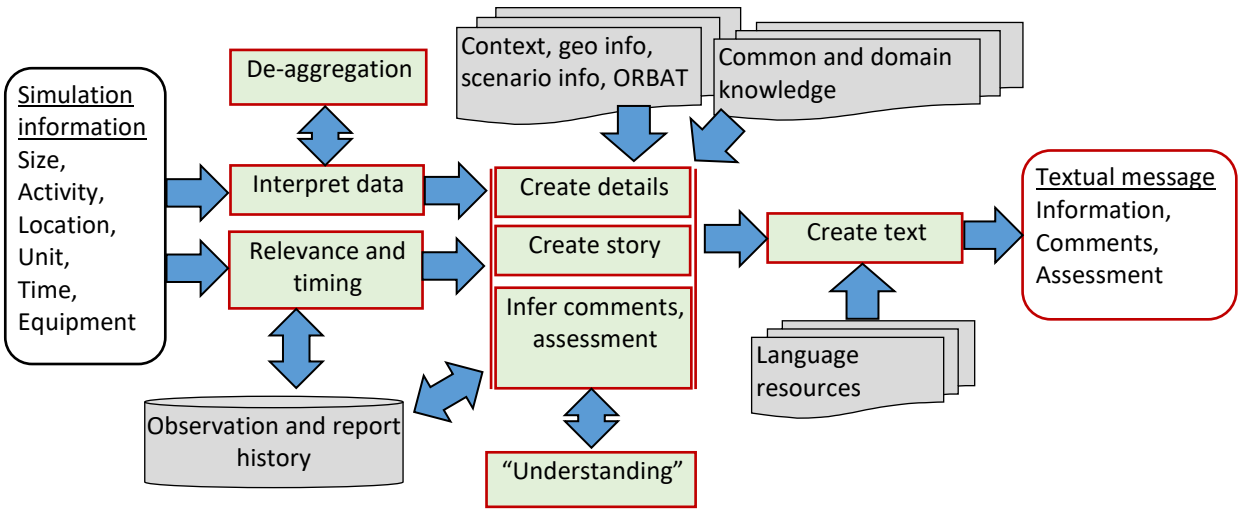

Figure 3-1: Schematic picture of the report generation process.

3.1 Descriptions

The description corresponds roughly to the SALUTE rule of memory (size, activity, location, unit, time, equipment) used in some English speaking countries. This information is available on the HLA federation in a raw data format, but can be translated into information interpretable to a human recipient. The information from the simulation systems is, depending on the resolution level and the sensor model in the simulation system, often too truthful yet having no details. For example, in case of the aggregate level simulation system employed, the observation is on the form of an own unit with specified identity code that has observed an enemy unit with specified identity code. In reality, there is a person making an observation with her ears and eyes or interpreting the output of a real world sensor. The observed items are individual objects such as vehicles or people, with markings and signs of wear and tear. Furthermore, a human observer has a great load of background knowledge to interpret what is seen, something that has to be explicitly encoded for the machine to make similar connection. From a list of holdings for the observed unit, the report generator get access to individual vehicles or equipment. Then an ontology including several ways of describing and object is used to be able to make references to it, see for example table 3-1. Several other sources of information, common knowledge, domain knowledge, or pertaining to the exercise scenario, collectively referred to as a knowledge base, are used likewise. A challenge that remains even if having a fully developed report generator, is to fill the knowledge base with information and keep it up to date and adjusted to a particular exercise.

Table 3-1: Example of descriptions needed to make realistic textual messages.

Crude simulation data	**Verbalized information**	
Simulation identifier: CV-90	Type of object:	*military tracked armored fighting vehicle*
	Typically called:	*CV 90*
	How to describe it:	*boxed shaped with a slanting front and big turret and large main gun*
Simulation identifier: Mi-8 Hip	Type of object:	*armored rotary wing military transport aircraft*
	Typically called:	*military helicopter*
	How to describe it:	*twin engine on top, big round cockpit, rear tail rotor on left hand side, two double-mounted machine guns*

Among these, geographical information is one of the most important one, including both name labels for villages, roads and points of interest close to the coordinates for the observation and directions and distances to nearby locations and positions for previous observations or own units. As an example, some vehicles might be "*spotted in vicinity of Kungsängen, marching west on Road E18 towards Enköping*".
Practically the texts are built by selecting and manipulating a range of paragraph and sentence scaffolds, adjusted and varied to fit the observation as well as to create messages formulated in a realistic and credible way. The original idea was to use more sophisticated techniques (see for example [5]), but these have not been possible to implement due to the limited budget and selected focus for the project.

3.2 Comments and Assessments

Several observations can be gathered and described in the same report. Furthermore, it is necessary to make references to earlier observations related to the current one. This is included in the comments section. Here the history of observations kept by the report generator is employed to find for example observations by own units in the same geographical area. The intelligence report ends with an assessment, interpreting what has been seen in a bigger picture or judging enemy activity. This assessment is basically what the research field of data fusion or information fusion is trying to provide for real data to military C2 systems.[6] This seems like an insurmountable challenge to solve in prototype for automatic support to exercises. The raw data supplied by the simulation system does however contain for example the unit identity of the unit served (that took a whole lot of effort to translate into something less recognizable). This information set an automatic

exercise reporting tool on a great advantage to the information fusion community, and more ground truth information could potentially be extracted from the simulation system. This information can be obfuscated into "probably an infantry company of the 5th battalion" or similar assessments. For further technical specifications and details, see [7].

Subject Description

Advancing pick-up trucks IVO Hällbybrunn

141th Ranger platoon in QL have observed about four (4) Nissan KingCabs and Toyota Landcruisers marching west at 50 km/h. Symbol of black flag with three white verticle lines.

DTG 251335.

Comment

Vehicles with black and white insignias have previously been spotted in the QL area, reported at DTG 242035.

Subject Assessment

It is probable that the spotted vehicles belongs to a unit within Nobok irregular forces from Nobok Movement.

Figure 3-2: Example output from the automatic report generator.

3.3 Expanding the Scope

The prototype initially focused on one report type, expanding to provide three types of reports. A first report is send immediately upon incident or observation has occurred and includes very a rough and partial description, a second report with higher precision regarding what was observed is sent later "simulating" that more information has reached the staff for which the report generator is producing the report. Finally a summary of observations is compiled and sent periodically.

4.0 RESULTS, DISCUSSION AND CONCLUSIONS

As described above, to overcome the challenge of an accurate flow of information noted in staff training, a concept for an automatic textual report generator has been developed, together with a prototype. The prototype has been incrementally developed based on experiences from testing it in command post exercises. This has resulted in both experiences on technical challenges and requirements, as well as the response cell requirements.[7] A study on the effects of this report generator notes "…that automatic reports as a concept can increase the training effect of staffs…" and "Examples of benefits are reduced workload for participants in the exercise control and improvement in traceability and precision in the common operation picture.".[8] The ability to supply the response cell with detailed drafts that are "painting the picture" is said by interviewees in response cells to be the main benefit of the current prototype.

Staff at different command level require different reports, as do different functional units. There are also a range of reports that could be produced to ultimately alleviate the burden of reporting for exercise support staffs in staff training. The concept of automatic reporting independent of what simulation systems are employed is judged viable, but the road to a fully functional implementation encompassing all response cell needs remains long.

5.0 REFERENCES

[1] NATO STO (2015). Modelling and Simulation as a Service: New concepts and Service Oriented Architectures. Final Report of NATO MSG-131, STO-TR-MSG-131.

[2] See for example http://computationalcreativity.net for an introduction to Computational Creativity. See [3] for an example of a Twitter bot.

[3] Guerrero, I., Verhoeven B., Barbieri F., Martins P., & Perez y Perez, R. (2015) *TheRiddlerBot: A next step on the ladder towards creative Twitter bots*, Proceedings of the Sixth International Conference on Computational Creativity (ICCC 2015), Park City, Utah.

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[5] Kybartas, B. & Bidarra, R. (2017). A survey on story generation techniques for authoring computational narratives. *IEEE Transactions on Computational Intelligence and AI in Games*, 9 (3), 239-253.

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[8] Appelgren, M. & Runesson, J. (2018). Automatisering i simulering: Automatiserade rapporter i militära ledningsträningsövningar. Bachelor thesis, Högskolan i Halmstad, Halmstad (in Swedish).