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MODELLING COMBAT AS A SERIES OF MINI-BATTLES

BY

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1. This is the second Interim Report on a study which is investigating the feasibility of modelling conventional battalion level combat using the network battle concept and assessing the value of such an approach.

2. The original proposal for this study envisaged that the work programme would involve five major tasks:

   a. data collection and analysis,
   b. derivation of a suitable methodology for generating the network of mini-battles,
   c. investigation of various attrition methodologies,
   d. development and verification of a combat model,
   e. validation and assessment of the combat model.

The progress to date in each of these tasks will be discussed in turn.

DATA COLLECTION AND ANALYSIS

3. Although the divisibility of a battle into a series of separate small scale engagements is not a totally new concept, it was the analysis of trials data by Rowland et al (References A and B) at the Defence Operational Analysis Establishment (DOAE) in the UK which sparked off the current interest in network battle modelling.

4. As stated in the first Interim Report an analysis of the network structure of a number of battlegroup level combat models was subsequently carried out at the Royal Armament Research and Development Establishment (RARDE) in the UK and at RMCS. However, further data on the relationships between the battle scenario and its network of mini-battles are still required, and two potential sources of information are currently being pursed:

   - DOAE modelling work using a stylised representation of terrain,
   - an analysis of the ARCOMS data derived from trials held at Fort Hood, Texas.

Key words: Mathematical models, AW

5. The work at DOAE is progressing slowly and producing some interesting results, but as yet no official report has been produced. RMCS are hoping to be able to assist DOAE with this particular study later in the year, and thus obtain some results for use in modelling the generation of combat models.

6. The official request for the release of the ARCOMS data to the UK is still being processed.

METHODOLOGY FOR GENERATING A BATTLE NETWORK

7. Using a network as the basis for modelling an engagement, as opposed to using the concept as a framework to describe the history of a battle, poses the problem of how to generate the network.Several approaches have been suggested:

a. a highly aggregated statistically based approach,
b. the use of a predetermined network,
c. an expert system based approach.

8. As mentioned in the first Interim Report the current work is concentrating on the use of a predetermined or pre-set network. This network would be terrain and scenario related, and RMCS have acquired a terrain data base to use in this phase of the work. The intention is to try and develop an automated process for the generation of the pre-set network.

9. Some of the implications of using a pre-set network are also being investigated and this work is discussed in paragraphs 14 and 15..

10. The highly aggregated statistically based approach has also been considered, but as anticipated the lack of the necessary data mean that this is not a feasible alternative at the present time.

ATTRITION METHODOLOGIES

11. In a network based combat model the opposing forces will fight a series of mini-battles, and hence the attrition methodology used must be one appropriate to engagements involving a relatively small number of weapons on either side. Two main methods of determining attrition are being considered:

    a. a Lanchester based approach
    b. a duel based approach.

12. Having studied the standard Lanchester approach and the critique of the Lanchester methodology produced by Ancker (Reference C), RMCS have started to develop a modified Lanchester type model. In this modified approach each surviving weapon is considered as being in one of two states: observing or firing. Preliminary results from this work have been compared with a standard stochastic Lanchester formulation and with a Monte Carlo simulation, and progress so far is encouraging.

13. The alternative approach based on extending a stochastic duel model to few-versus-few engagements appears to be exceedingly complex and mathematically intactable. However, using such duel models to develop an acceptable aggregated model looks to be a possible way ahead, although this idea has not as yet been studied in any depth.

DEVELOPMENT OF A COMBAT MODEL

14. Having demonstrated the considerable effect that structuring combat as a series of mini-battles can have using a very simple Lanchester based simulation model, RMCS have now developed a simple network model. This model uses a pre-set network and again a stochastic Lanchester based attrition methodology.

15. The model is currently being used to study the effect of various network parameters (e.g. number of nodes and number of links) on the outcome of the battle. The effect of other combat related parameters (e.g. average force ratio in mini-battles) will also be investigated, and the results will be compared with an equivalent force-on-force combat model. Some first tentative conclusions from the work on developing a combat model using a pre-set network are:

a. it is the decision rules for fighting the forces through the network that are the critical factor whether the network be pre-set or whether it evolves as the battle progresses

b. a pre-set network for a real battalion level battle will be exceedingly large and complex, and may require an unacceptable level of computer support.

16. Obviously the work has not yet progressed to a stage where there is a fully working combat model to be validated and assessed as a study tool.

CONCLUSION

17. Progress is being made in the various tasks identified for this project, and a number of models have been developed to investigate different aspects of the work. RMCS will be discussing the work to date and the future programme at a meeting with the Scientific Liaison in the US at TRAC-WSMR on 14/15 April 1987. A final and full report on the first year's work will be issued by the end of November 1987.

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