THE ROLES OF ARTIFICIAL INTELLIGENCE IN BATTLEFIELD COMMAND SYSTEMS

Michael J. Ryan

Abstract. As the pace of modern battle has increased, headquarter staffs have had to process increasing volumes of information in a decreasing amount of time. Assistance in this critical task must be provided by computer-based command systems that can automate time-consuming tasks. However, conventional computer-based systems provide only limited assistance in the intellectual tasks of planning and decision making. Potential to assist in these areas is provided by artificial intelligence (AI), which is vaunted as the next great revolution in information processing. This paper addresses the potential roles of AI in battlefield command systems. AI is briefly introduced, as are the relevant command and control tasks. The potential roles of AI are then discussed for each of these tasks and three operating modes are proposed to provide a framework for the consideration of new AI applications as they are developed.

INTRODUCTION

The number and sophistication of battlefield sensors and the capacity of communications systems have increased dramatically since World War Two. The subsequent expansion in data collection and reporting capability has led to a large increase in the volume of information received by a headquarters. At the same time, however, the pace of modern battle has meant the time available for decision making has correspondingly decreased. The disparity between the vast amount of information received and the time available to process it, cannot be reduced by simply expanding the size of the processing staff. The only solution lies in the extensive application of automation to process large volumes of information. Most modern battlefield command systems are therefore automated to some degree to increase the ability of the staff to handle many detailed and time-consuming tasks.

Conventional computer-based systems are very useful in automating many time-consuming tasks such as message formatting, document distribution, database search and digital-terrain display. They are extremely limited, however, in their ability to provide assistance in the intellectual planning and decision-making processes, such as preparation of appreciations and plans. Potential to assist in these areas is promised by the field of artificial intelligence (AI) which has been vaunted as the next great revolution in information processing.

AI-based planning systems promise an ability to monitor complex situations, to assimilate large quantities of data quickly, and to predict likely outcomes of possible courses of action. It is this ability, so crucial to command systems, that cannot be provided by conventional computer systems. Unfortunately, however, despite some 40 years of research, AI has delivered very few successful contributions in this critical area. Still, AI-based systems appear to offer the only solution to the types of processing required by commanders on the modern battlefield. Therefore, before AI can be considered for inclusion in operational command systems, its potential roles must be assessed correctly.

A BRIEF INTRODUCTION TO AI

The term 'artificial intelligence' was introduced in 1956 and is now in common use. AI is as difficult to define as intelligence itself, but is perhaps best considered as: '... the interdisciplinary attempt to understand the nature of cognitive problem-solving and apply that understanding via computer hardware and software'[1].

There are a number of important differences between AI systems and conventional computer systems. Conventional systems use an algorithmic or procedural approach to problem solving in which there is a guarantee of success in a finite time. They use a step-by-step approach to store and manipulate data (numbers) within specific processing boundaries. To be successful, however, the program must contain all possible combinations of inputs and data values. In an extremely complex environment, such as the battlefield, the size of a conventional program (even if it was realisable) would be too large to be useable in a timely manner.

In AI systems, the software is non-procedural and can determine for itself how to continue in a given situation. The system stores knowledge and applies it to a variety of unspecified problems. Conventional systems cannot infer beyond certain pre-programmed limits, but AI systems can make inferences, implement rules of thumb, and solve problems in an adaptive manner. They can contemplate multiple, competing hypotheses simultaneously. They can function with data that contains errors, using imprecise judgemental rules. AI systems represent and use symbolic information (as opposed to using only numbers) and use heuristic processes (as opposed to algorithmic processes). Heuristic processes are problem-solving methods that may not lead to a solution but offer a shortened path towards the answer.

AI research covers a wide field but tends to focus on three main functions:

- **Artificial Sensing.** Artificial sensing involves the conversion of verbal and optical information to text. It seeks to extract information from electronic images and signals without human interpretation. There are two main research areas:
  - ***Vision Systems.*** This research aims to produce systems that are able to sense their environment, such as in automated manufacturing. On the battlefield, the aim is to interpret automatically images received from sensors and reconnaissance means.
  - ***Speech Recognition.*** Speech recognition, or conversion of the spoken word into text, allows computers to understand humans without a