Chapter 1
Intelligent Fighter Pilot Support for Distributed Unmanned and Manned Decision Making

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ABSTRACT

This chapter highlights important aspects of an intelligent fighter pilot support for distributed unmanned and manned decision making. First the background is described including current trends within the domain, and characteristics of a decision support system are discussed. After that a scenario and example situations are presented. The chapter also includes reflections of an intelligent fighter pilot support for distributed unmanned and manned decision making from the joint cognitive systems view, regarding human interoperability, and function allocation.

INTRODUCTION

This chapter aims at, identifying and systematically describe, system characteristics and contextual constraints of an intelligent fighter pilot support system for distributed unmanned and manned decision making. Specifically an analysis based on a literature review of state-of-the-art is presented as well as domain specific lessons learned from systems design within this field. Also, the chapter contributes more generally to guide and motivate students and researchers to perform similar contributions in adjacent domains of intelligent applications for heterogeneous system modelling and design.

In the technology-intensive domain of fighter aircraft it is important to design for human factors by regarding what is special about that specific context (Alfredson & Andersson, 2013), and to successfully apply cognitive design principles (Alfredson, Holmberg, Andersson, & Wikforss, 2011). For instance, human-centred automation guidelines could be applied to the fighter aircraft domain (Helldin, Falkman, Alfredson, & Holmberg, 2011). Also, design principles for adaptive automation and aiding have been

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provided by Steinhauser, Pavlas and Hancock (2009). Already today and more so in future contexts, a fighter pilot has to interact with intelligent applications for heterogeneous systems where transparency is important (Helldin, 2014).

BACKGROUND

In the early days of aviation keeping the aircraft in the air was hard enough. The aviators were fully occupied by piloting. However, after some years of progress within the domain the aircraft could be better controlled in the air and there was also time to regard other activities. The pilots found time not only to aviate but also to navigate. In the military domain pilots could communicate what they had observed on the ground after they had landed, which could provide important reconnaissance information. Later, the history of military aviation is full of various types of aircraft performing very different missions in numerous scenarios. Fighter pilots of today make use of a flight control system or an "autopilot" or other functions to aid the piloting of the aircraft. Also, modern fighters are equipped with advanced sensor suits, high tech weapon systems, electronic warfare systems and many other subsystems that a modern fighter pilot has to manage. If you were ever given the opportunity to look at the instrumentation of a modern fighter aircraft performing a tactical mission you would probably see that instrumentation and displays to a great deal is used for tactical considerations and not only for flight instrumentation. The role of a fighter pilot has been transformed over time; from pilot to tactical decision maker.

This long term trend has led to current situations where a fighter pilot has to manage several tactical subsystems simultaneously and, at the same time, assess on going parallel tactical situations on the ground and/or in the air and make fast and important decisions to provide influence of the situations. Many situations are very applicable to naturalistic decision making as it were characterised by Klein, Orasanu, Calderwood, and Zsambok (1993). Situations are often complex, uncertain and dynamic characterised by high stakes, potentially risking both own and others life under extreme time pressure, calling for naturalistic decision making. Also, demanding situations may appear suddenly when performing almost any military mission, either it is an air-to-air mission, an air-to-surface mission or a reconnaissance mission. Also civil aviation can at times also be very demanding and dynamic at times, even though the military component of foes influencing the situation adds an extra need for specific decision making and corresponding decision support.

Today, and even more so in future aircraft systems, the pilot has to regard and interact with more and more information, if this trend will keep developing in the same direction and pace. This trend increases the need to support decision making. At the same time, there is a trend towards increasing abilities to support decision making. For instance, the computational power of modern avionics has increased substantially and the human-machine interaction technology has been improved, providing fighter aircraft engineers with new means of supporting fighter pilot interaction during demanding situations. There has been a long term trend towards increasing communication abilities between pilots not only including oral communication but also various means of data communication, allowing new means of communication between pilots as well as with command and control functions and more. Also, the cognitive ability for technical agents that the fighter pilot is in contact with, either direct by own manipulation and control, or indirect through another human, is increasing. Examples of technical agents that could influence the situation for a fighter pilot is a decision support system in the own aircraft as well as equivalent systems on other platforms, autonomous or highly automated unmanned aircraft or command and control