Current Research

RATaC
Rapid (Human Factors) Assessment of Tasks and Contexts For Synthetic Environments and Serious Games

The availability of affordable hardware and software packages, such as 3D graphics accelerators and games engines, hosted within commercial, off-the-shelf PC platforms, is resurrecting interest in the adoption of Technology-Based Training (TBT) systems based on interactive 3D ("i3D") for applications in training. Attention is now turning to more human-centred issues, focusing on appropriate content, sensory and functional fidelity, interaction style and the need for specialised display and control peripherals. Based on over a decade of research and development, the RATaC methodology has been designed to overcome some of the logistical, timing and financial restrictions faced by human factors specialists in trying to capture – during live, in-the-field, or operational assessment sessions with actual end users – the key components of training scenarios for the purposes of defining the scope of TBT solutions, particularly those based on i3D (e.g. VR or serious games).

Interactive Trauma Trainer

A proof-of-concept demonstrator project, part-funded by the Human Factors Integration Defence Technology Centre and developed by TruSim (a division of Blitz Games, UK and a co-founder with Birmingham of the UK Serious Games Alliance). Designed in conjunction with the subject matter experts from the Royal Centre for Defence Medicine, the Interactive Trauma Trainer is the result of an intensive human factors project, based on RATaC analyses conducted with RCDM and Army Field Hospital specialists. The task of the user is to make appropriate decisions relating to the urgent treatment of an incoming casualty with a "Zone 1" neck fragmentation wound. Appropriate interventions – oxygen provision, blood sampling, "hands-on" body checks, patient visual and physiological observation, endotracheal intubation – must be applied within 5-6 minutes in order to save the virtual casualty's life.

Pulse!!

The University of Birmingham and Human Factors Integration Defence Technology Centre are taking part in an exciting US medical serious games project called Pulse!!, developed by Texas A&M University Corpus Christi. Funded by a $4.3 million federal grant from the Department of the Navy's Office of Naval Research, this new "Virtual Learning Space (VLS)" initiative will provide an interactive, virtual

environment in which civilian and military heath care professionals can practice clinical skills in order to better respond to catastrophic incidents, such as bioterrorism. Birmingham University specialists are serving as consultants in collaboration with others from the University of Central Florida and University of Southern California in the development of the human-centred design aspects of Pulse!!, from task analysis and human interface design to the generation of evaluation metrics.

Aberrant Anatomy

The internal anatomical structure of the human body is not always as “standard” as the text books suggest. Occasionally, and as a result of genetic aberrations or subtle differences to the ways in which organs and their interconnecting vessels have developed, aberrance is witnessed. Such variations can lead to difficulties during surgical interventions, in that surgeons may make false assumptions about the way in which an anatomical structure or group of structures are presented. Inappropriate decisions and actions taken on the part of the surgeon can lead to irreversible procedures being applied, leading to costly and often debilitating mistakes. This research seeks to understand why these surgical errors are made and is based on an experimental gaming implementation (based on the Crytek/Ubisoft CryEngine) of realistic anatomical structures, particularly those in the hepato-biliary region of the human body.

Alchemy 1 & 2 Unmanned Vehicle (Land/Air) Demonstrators

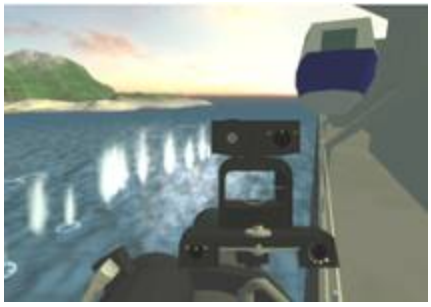
An experimental human factors test bed designed to support the development of new guidelines and standards relating to operator display and control requirements for iSTAR UAVs (Intelligence, Surveillance, Target Acquisition & Reconnaissance Unmanned Air Vehicles), deployed in support of homeland security operations in urban environments and close-combat missions in foreign environments. The original Alchemy test bed took the form of an affordable and reconfigurable Synthetic Environment (SE) system, based on Microsoft’s Managed DirectX 9.0 API, the C# .NET language and appropriate games engine technologies. More recently, with Alchemy 2, the test bed has been ported onto the Crytek/Ubisoft CryEngine and developed further to demonstrate the deployment of iSTAR UAVs in support of special operations. The Alchemy 2 environment is currently being used to support the introduction of new uninhabited vehicle (medium-altitude / urban combat support). single-person turbofan (Personal Air Vehicle - PAV) and cargo transport concepts for Kestrel Aerospace, a member of the Midlands Aerospace Alliance.

Helicopter Rear-Door Aircrew

This project was designed to assess the role of vibration in the tasks undertaken by aircrew located in the rear cabin of helicopters whose job it is to guide the pilot using verbal instructions during an approach toward a target (on land or sea) for the purposes of rescue or load deposit. The first phase of the project resulted in the development of a vibration sensing device which was flown on an EC-203 helicopter whilst performing a range of typical marshalling manoeuvres. The data collected were then used to drive a 3-axis modified entertainment simulator motion base, linking the simulator motion and vibration to interactive 3D graphics developed using Microsoft's Flight Simulator 2004. A more permanent control system supporting the integration of gaming technologies with the motion base platform is being developed for use in conjunction with developments in the application of games engine technologies to the design of, and training for future specialised air vehicles (as investigated under the Alchemy programme).

Part-Task Training for the Royal Navy's Dillon Minigun

The M134 Dillon Minigun is an electrically powered Gatling Gun capable of delivering 3000+ belt-fed 7.62 rounds per minute. Following experiences in Operation TELIC, the Royal Navy has decided to fit a variant of the M134 to a number of its vessels, for close-in combat and ship protection purposes. The experimental game-based trainer being developed as part of the HFI DTC research programme is addressing a number of key issues, including the unique "hosepipe tracking" behaviour demonstrated by the weapon aimers and weapon "kick-down" brought about by the significant torque induced by the rotating barrel.. Videos of tracer streams from the Minigun depict a firing pattern similar to hosepipe spraying in order to improve time-on-target. This, coupled with the fact that the aimer's ship will be undertaking extreme manoeuvres, stresses the need for an appropriate weapon skills trainer. The scope of work has been defined following a RATaC analysis of Minigun aiming activities onboard HMS Roebuck in the English Channel in October 2005. The Minigun simulation was developed by an EECE MEng student using the Crytek/Ubisoft CryEngine 1.

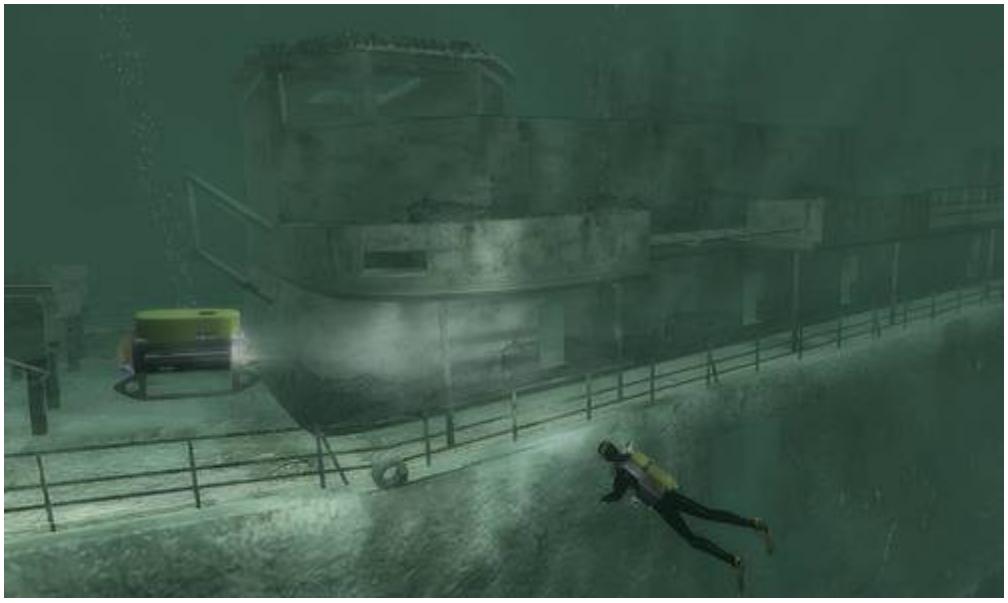


Pre-Simulator Performance Capture Tool for Junior Warfare Officers (Royal Navy)

Increasing student failure rates during bridge simulator navigation courses have been noted by RN officials. It is suspected that this is occurring as a result of the students' apparent inability to be able to correlate 2D information on charts and radar screens with the actual dynamic 3D situation out of the simulated bridge windows. The failure rate situation has, apparently, been evolving since the introduction of the Junior Warfare Officer (JWO) simulators in December of 1995. There appears to be a very strong case for investigating these issues further, analysing the tasks the JWOs are required to perform, with the aim of collecting performance data from JWOs before they are committed to simulator courses. A RATaC analysis, conducted within the bridge simulation facilities at HMS Collingwood in Fareham, has confirmed this and a laptop-hosted perceptual and cognitive performance capture tool has been designed by and EECE MEng student to investigate such issues as spatial orientation and collision threat detection as part of a longitudinal study. The performance capture tool includes various primary tasks, such as compensatory tracking vessel collision threat detection (form simulated "radar" screen and forward/aft own-ship views, safe distance maintenance, bearing and speed corrections. Secondary cognitive tasks, based on arithmetic or textual problems, are also part of the tool, which drew its inspiration from an early and popular DOS game, Elite).

Virtual HMS Scylla

HMS Scylla is a Batch 1 Leander Class Frigate that was scuttled in March 2004 off the Cornish Coast by the National Marine Aquarium, based in Plymouth, to become Europe's first artificial reef. Working together with colleagues from the NMA and the University of Plymouth, a dynamic virtual model (exploiting an appropriate games engine) of the Scylla. The initial model is based on her condition as she exists at this point in time, and the project will be to research, develop and apply Artificial Life (ALife) algorithms to model (and predict) the growth and propagation of marine organisms over time, taking into account the effects of subsea changes brought about by climatic events and pollution. Birmingham University has already developed a unique software system, called the Seeder Engine, as part of a Virtual Environment project to populate a topographical model of the recently-discovered Mesolithic riverbed area in the southern basin of the North Sea, as it existed prior to flooding caused by glacial melting (12-13,000 years ago). The Team has already had great success in populating the original 3D model with appropriate flora (using data culled from pollen and other microscopic samples obtained from regions around the North Sea basin)



Of course, not being able to travel back in time, it is not possible to confirm the results of the Mesolithic ALife models. However, applying the present research to the Scylla scenario would help, not only to validate the Seeder Engine effort, but also to provide predictive visualisations of what the reef might look like tens of years (and longer) into the future and, eventually, to assess the impact of possible global climate changes on the sea and other factors, such as the effects of pollution or other short-term environmental variations. The project involves NMA and Marine Biological Association subject matter experts, particularly in respect of the marine flora and fauna that will eventually inhabit the reef (also obtainable via the MarLIN Database, their growth and reproduction patterns, their responses to subsea environmental changes (pollution, temperature, etc.). More at http://virtualscylla.org/.

SubSafe

An original report published by Prof. Stone in 1999 and commissioned by Flag Officer Submarines (FOSM) presented the results of a feasibility study addressing potential uses of new interactive media technologies to train emergency systems spatial awareness in Trafalgar Class vessels.

The study described a potential solution based on combining simple 3D models of the main submarine decks and compartments with 360-degree digital panoramas. Digital panoramas were chosen to overcome the huge financial and computational costs of implementing every pipe, cable, valve and other object or system evident onboard vessels of this class. More recently, the Birmingham Human Factors Integration Defence Technology Centre Team (HFI DTC;) was invited to coordinate a new SMQ(D) study in which a comprehensive interactive computer model of an SSN submarine would be “constructed”.

The HFI DTC contracted a small Shaftesbury-based company, Incredible Box, to work alongside the Centre’s human factors serious games researchers to develop an interactive 3D model of a

Trafalgar Class submarine. The project also involved working closely with training personnel at SMQ (South), part of the Royal Navy's Submarine School based at HMS Drake in Devonport.

Using a freely available, freely distributable open-source engine called Ogre (Object-Oriented Graphics Rendering Engine) and following the content, fidelity and embedded metric editor requests from the HFI DTC, the Incredible Box team produced a 3D SSN model from scratch, having only been given photographic access to HMS Trenchant for a total period of 7 hours over 2 days.

Using simple mouse and arrow key commands, users can proceed from the virtual quayside onto the submarine and explore 3 decks forward of bulkhead 59 (aft of the control room). The virtual submarine model consists of some 30 compartments and 500 different objects. A comprehensive evaluation of the SubSafe tool is planned for 2008. Three experimental groups are envisaged – "control" (SMQ trainees in this group will not be exposed to SubSafe), "passive" (screen-based presentation of SubSafe to the trainees by SMQ South instructors) and "free-roam" (hands-on exposure of SubSafe to the trainees).

The participants' performances in locating safety critical items during their walkthrough onboard an actual submarine in week 7 of each participating SMQ(D) course will be recorded by means of instructor ratings and feedback. The data will then be analysed to assess what, if any, benefits are afforded by SubSafe to trainees, over and above the PowerPoint-style training they currently receive. Knowledge fade will also be investigated, especially with those participants who return to Devonport having taken part in 6-month career-oriented training immediately following the SMQ(D) course