



Defence iQ - Surface Warships Conference
London - 25/26 January 2017

Adaptable and Ready

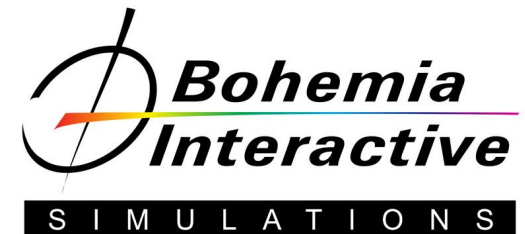


Training & Simulation for Surface Warships

Andy Fawkes

My Background

- Royal Corps Naval Constructors
- 1985 – SSBN Main Machinery Project
- 1990 – Taught Naval Nuclear Engineering
- 2000 – MoD Lead for Simulation Policy
- 2006 – Chair NATO Modelling & Simulation Group
- 2012 – Consultant and BISim Academic Outreach





- **Wide Subject**
- **May Stray beyond Maritime**
- **A Lot of Slides!**

Will Consider...

- **Inspirations**
- **A Little History**
- **Simulation Now**
- **Why Simulation?**
- **Other Training Technologies**
- **Are Humans Redundant?**
- **Simulation and Decision Support/C2**

Human Factors and Training often the Last Among Equals in Defence Procurement



Training is an Essential Component of Military Capability

UK MoD Defence Lines of Development:

- Training
- Equipment
- Personnel
- Information
- Concepts and Doctrine
- Organisation
- Infrastructure
- Logistics

Training Requirement

Better



Faster



Cheaper



Drivers

Less Certainty



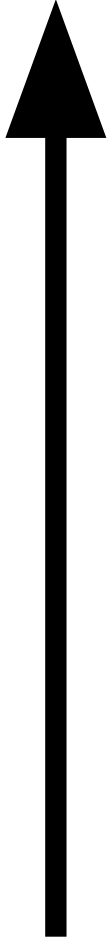
Less People



More Autonomous Systems



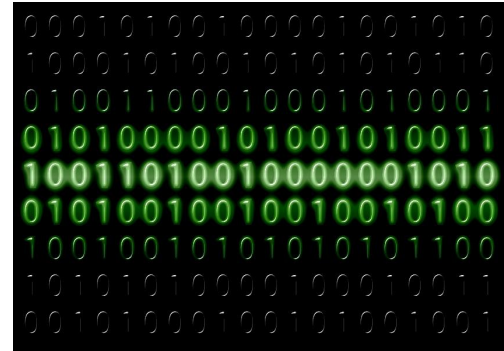
Adaptability



People



Digital



Metal



People are the Most Adaptable Component of Military Capability



Some Inspirations

Unforgettable?





Sir Jock Stirrup

Chief of Defence Staff

2007 RAeS Edwin Link Lecture

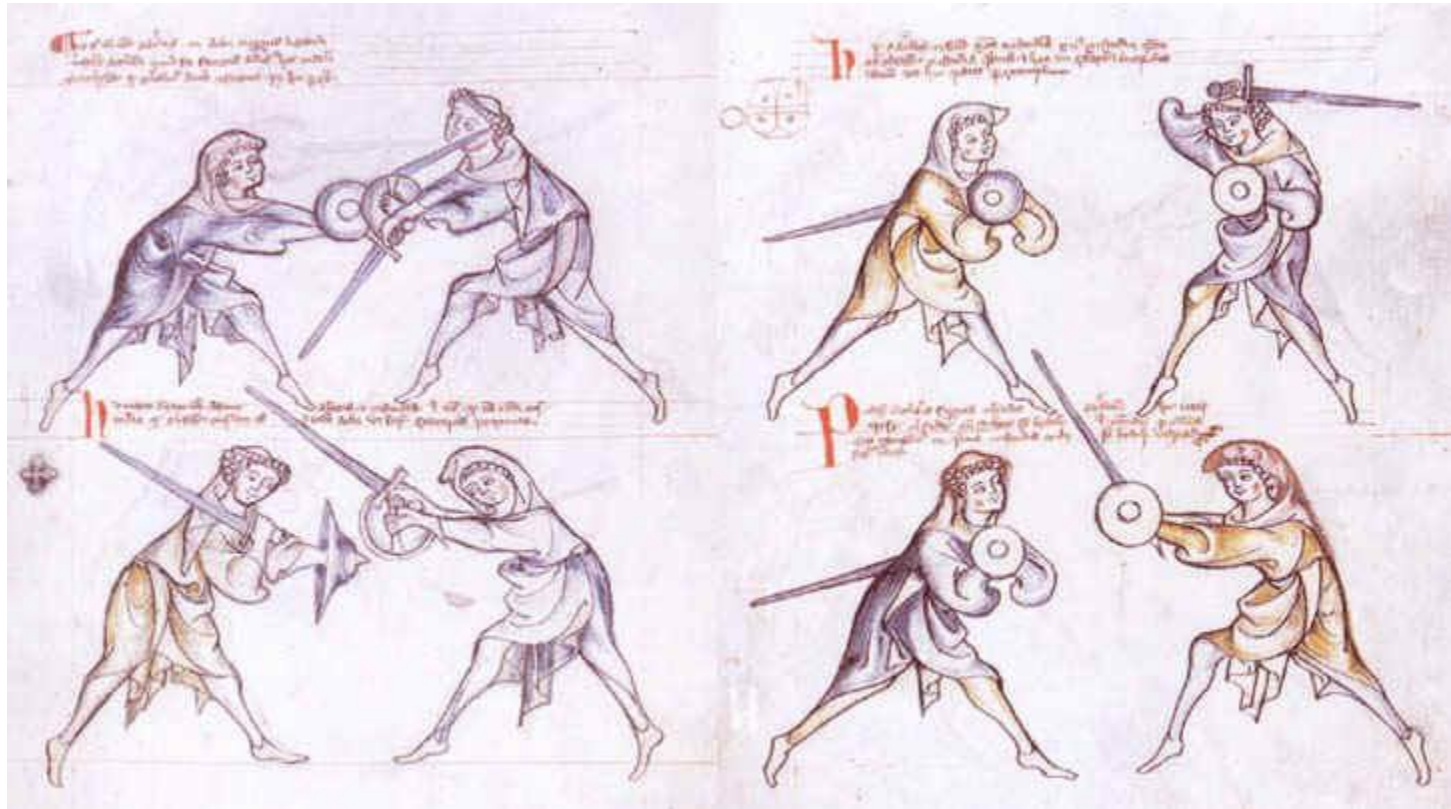
- “...the crew of a submarine when it is submerged in many ways are already operating in a virtual environment...”
- “...we can see emerging *the fuzing of* synthetic and real world environments *such* that would be it would it make increasingly difficult to distinguish between training carried out in simulation and the real thing.”



A Little History

Oldest Surviving Training Media

13th Century German Sword & Buckler Manual



1812 - Kriegsspiel (lit: "war play")

- Key features: map grid; different terrain types; gaming pieces; dice; fog of war and communication difficulties; impartial third party referee



THE AUTUMN MANOEUVRES—OFFICERS PLAYING AT KRIEGSSPIEL, OR THE "GAME OF WAR"

1904 – Royal Navy Portsmouth



A MEETING OF THE PORTSMOUTH NAVAL WAR GAME SOCIETY IN THE NELSON ROOM AT THE "GEORGE," PORTSMOUTH.

The Naval War Game and How it is Played.

Link Trainer (1940s)



UK Fleet Air Arm Link Trainer (1943)





Source - UK Urban Exploitation Forums - Crail Airfield [HMS Jackdaw/HMS Bruce/JSSL]

1970s/80s Flight Simulation



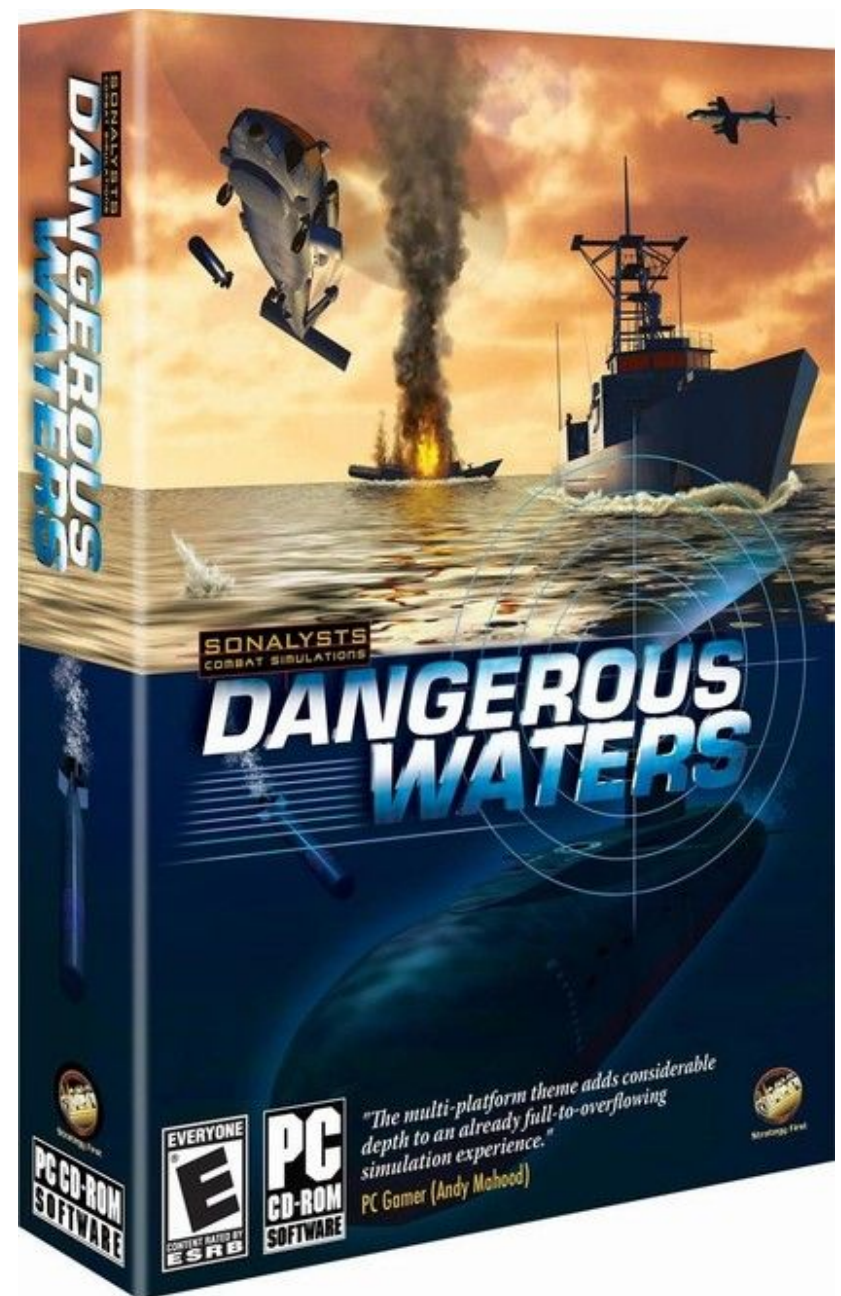
Naval Flight Simulation (1970s)



1990 - US Navy Battle Force In-Port Training (BFIT)



Computer Games! (2005)



Computer Games in Training - 2008



[HOME](#) » [NEWS](#) » [NEWS TOPICS](#) » [HOW ABOUT THAT?](#)

Royal Navy use PlayStations to train sailors

The Royal Navy has begun a programme to issue hand-held PlayStation computer consoles to sailors so they can study for tests in confined quarters.



Marine warfare engineering technicians were the first to receive the devices, and if proved useful they will be distributed around other personnel. Photo: GETTY

7:16AM GMT 27 Nov 2009

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How about that?

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In Politics

Digital Media Consumption



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Simulation Now

Simulation/Gaming Now



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UK Type 45 Destroyer High-Detail Model (300 Compartments)

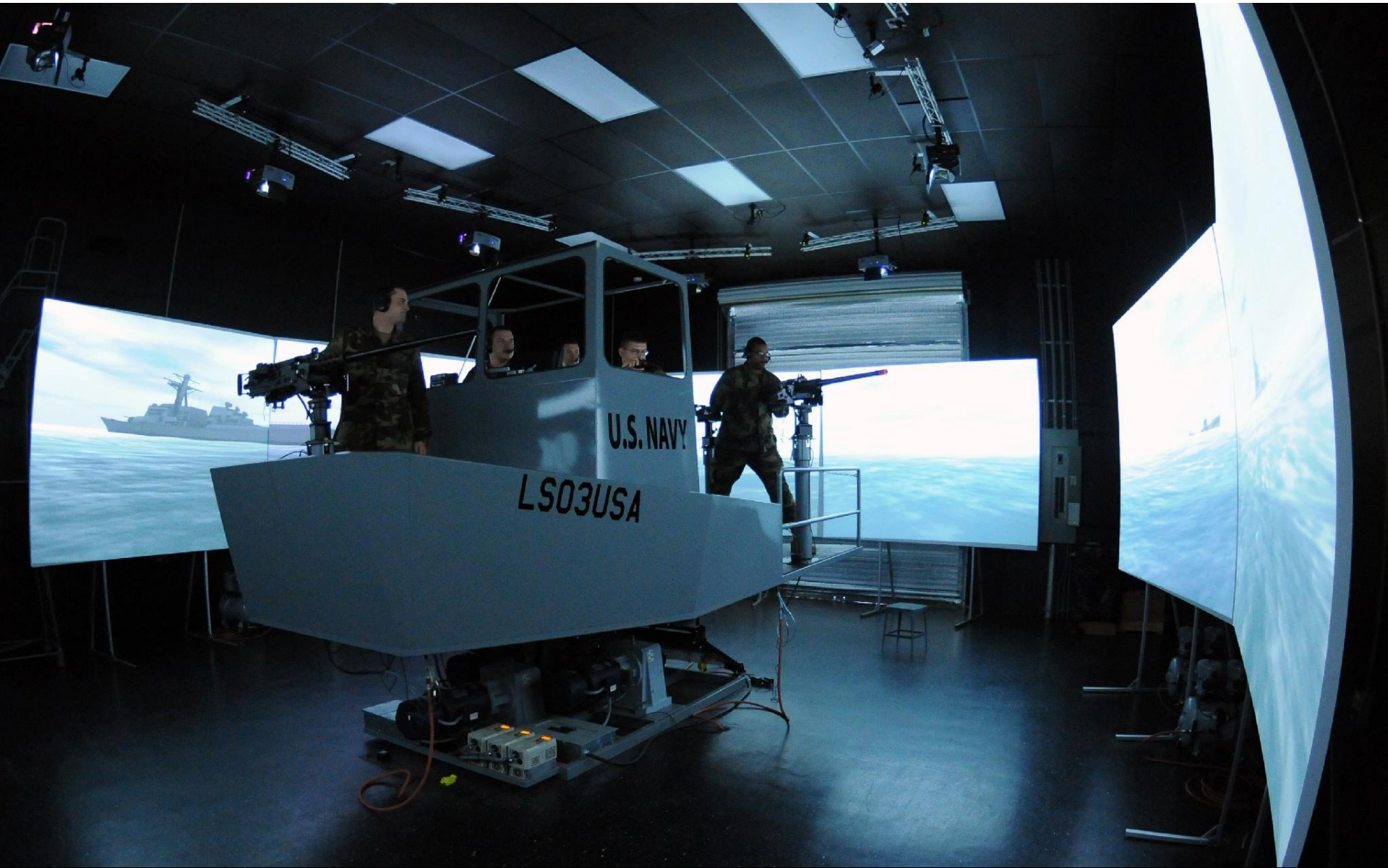


Boat Launch Training Simulation

- Correct launch sequence in model
- Integrate real control hardware
- Shore based training
 - New crew members
 - Refresher training
- Sea based training
 - Refresher training
 - Crew qualification



Laser Shot - Boat Crew & Naval Gunnery Trainer



Navy Programs using VBS3

- PMA-205 F-18F Virtual Reality Part Task Trainer Concept Demonstrator
- Naval Warfare Development Command (NWDC) Full Motion Video Program on Navy Continuous Training Environment
- US Navy Expeditionary Combat Command – Boat Crew Gunnery Trainer (Lasershot)
- NAVAIR - NGTS Integrated Pilot Stations
- Naval Surface Warfare Center (NSWC) – Electronic Warfare M&S
- Office of Naval Research (ONR) – Fleet Integrated Synthetic Training Testing Facility
- UK MOD/Royal Navy - Type 45 Destroyer Simulation for use in amphibious operations and ship familiarization, small boat operations, and gunnery training
- USMC – Full Enterprise License, DVTE, Squad Level training, Amphibious Operations Training
- US SOCOM - Seal training
- Australian Defense Force Warfare Center - Basic submarine, torpedo, Harpoon, air-to-air refueling
- Royal New Zealand Navy Close-In Weapons System Trainer (CISW)



Navy Training Tasks Supported by VBS3

- Ship/Job familiarization, maneuvering and navigation
- Air Crew Training and mission rehearsal
- Boat and Helicopter launch and recovery
- Man overboard drills
- Visit Board, Search, Seizure (VBSS) Training
- Fire fighting and damage assessment and control
- Close range weapon training
- Force Protection
- UUV/UAV/USV operations
- Disaster response and recovery
- Explosive Ordnance Disposal
- Soft skills including language and cultural
- Naval Gunfire Support
- Firearms Training
- Boat Crew Gunnery
- Parachute simulators
- Anti-swarm tactics

Maritime & Beyond - Simulation Now



When to use Games in Training?

- Games are proven to work for cognitive or “how to think” training.
- Games are not typically used to train motor skills, eg. shooting a rifle.



Simulation in Acquisition



UK Thursday War

Weekly war fighting and damage control exercises



UK Air Support to Defence Operational Training (ASDOT)

IOC - Q4 2019

Single Statement of User Need

- ‘The provision of live air support to Defence Force Elements in order to achieve the required Readiness States and operational assurance of Defence personnel and materiel’

Key User Requirements include:

- The User requires the ability train and assure its capability to exploit data in order to achieve shared situational awareness.
- The User requires the ability to plan, brief and debrief with ASDOT assets in an integrated and timely manner.

Fire Fighting Simulator



Why Simulation?

Simulation is Safer



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Saves Money



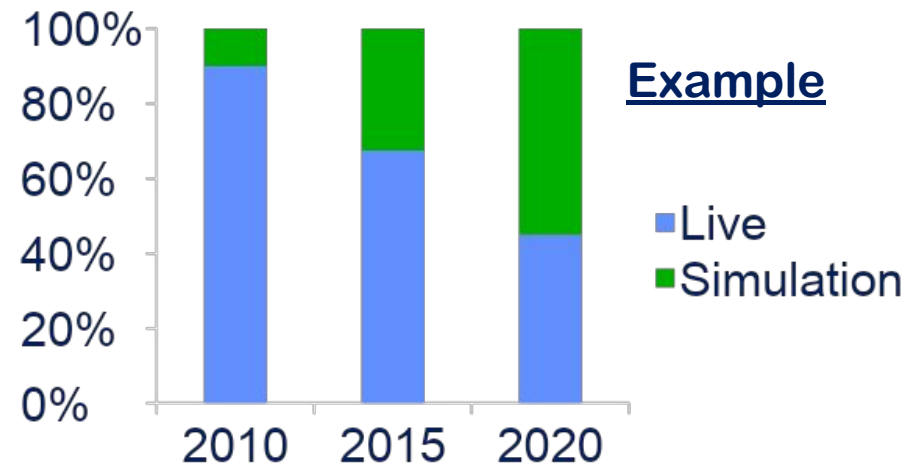
and...

- **Not affected by the Weather**
- **Less effect on the Environment**
- **Real Systems not Required**



2010 – UK MoD SDSR Simulation Targets

- Step Change in Exploitation of Simulation for More Cost Effective Training
- 25% Transfer Current Live Training to Simulation by 2015
- Further 25% Current Live Training to Simulation by 2020



RN Maritime Composite Training System



RN Maritime Composite Training System

An Alternative View

MailOnline

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High and dry: Cost-cutting Royal Navy forced to train new recruits on VIRTUAL ships

- Veterans and existing staff to be 'deployed' in front of monitors at two new bases which cost £108million
- Simulators open after Navy is left with aircraft carriers but no aircraft
- 1,000 people per year to be trained in 'replica operations room' which features banks of LCD screens

By [ROB COOPER](#)

UPDATED: 13:33, 6 December 2011

Other Training Technologies

loose definitions

- **Simulation**
 - Live – People in Instrumented Real World
 - Virtual – People in Virtual World
 - Constructive – Simulated People and World
- **Virtual Reality**
 - immersive multimedia through a computer-simulated environment
- **Augmented Reality**
 - real-world augmented by computer-generated sensory input
- **Mixed Reality**
 - merging of real and virtual worlds

COTS Rapidly Reconfigurable Simulation

- **Simulation/Visualisation can be rapidly adapted and exploited for mission training and rehearsal**



Google Earth VR



Pix4D

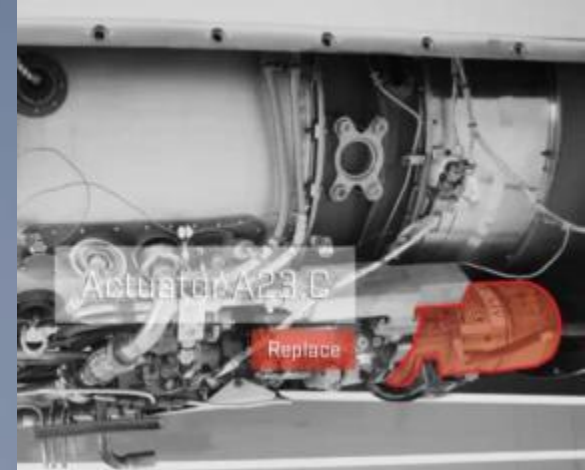
Virtual Reality



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Daqri Helmet



Augmented Reality in the Workplace



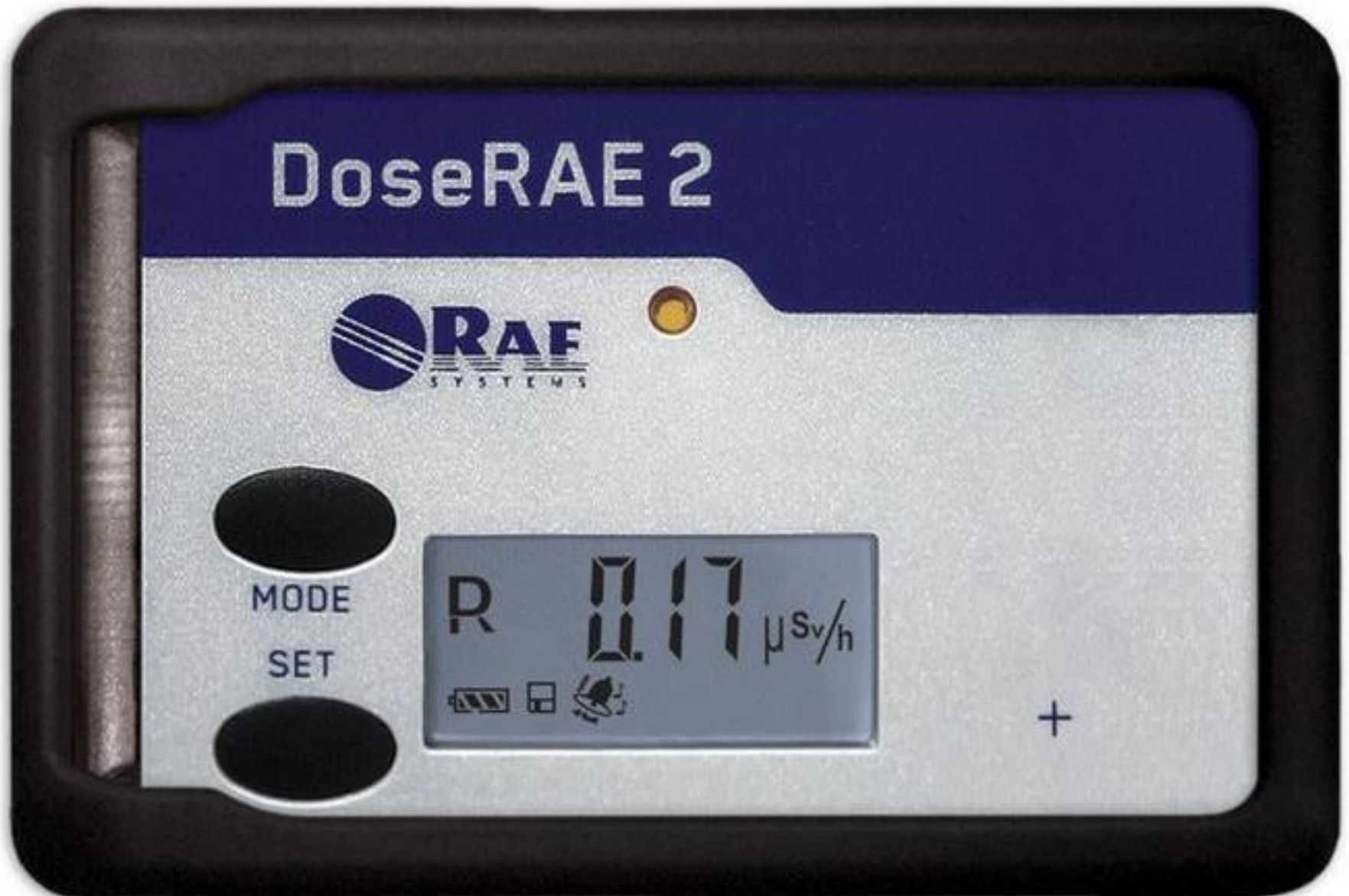
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Wearables



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Not New



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Physical Tracking

5:00

Sun, Oct 19

4 min



Sat, Oct 18

4 min



Fri, Oct 17

22 min

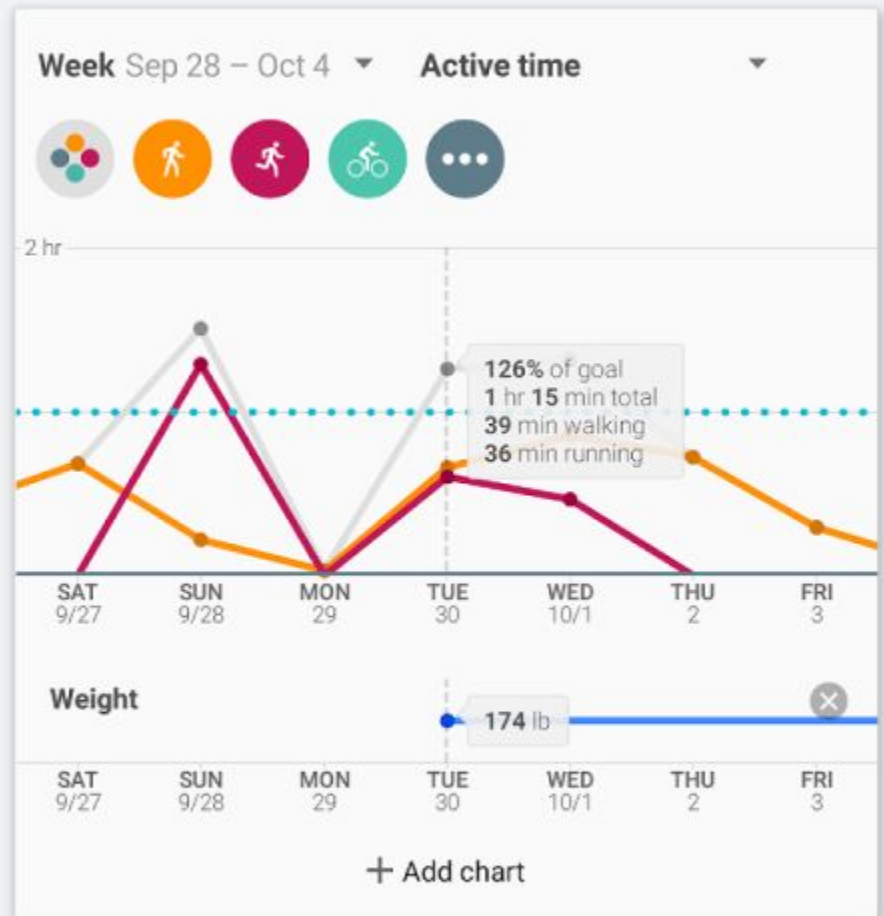


Thu, Oct 16

1 hr 8 min



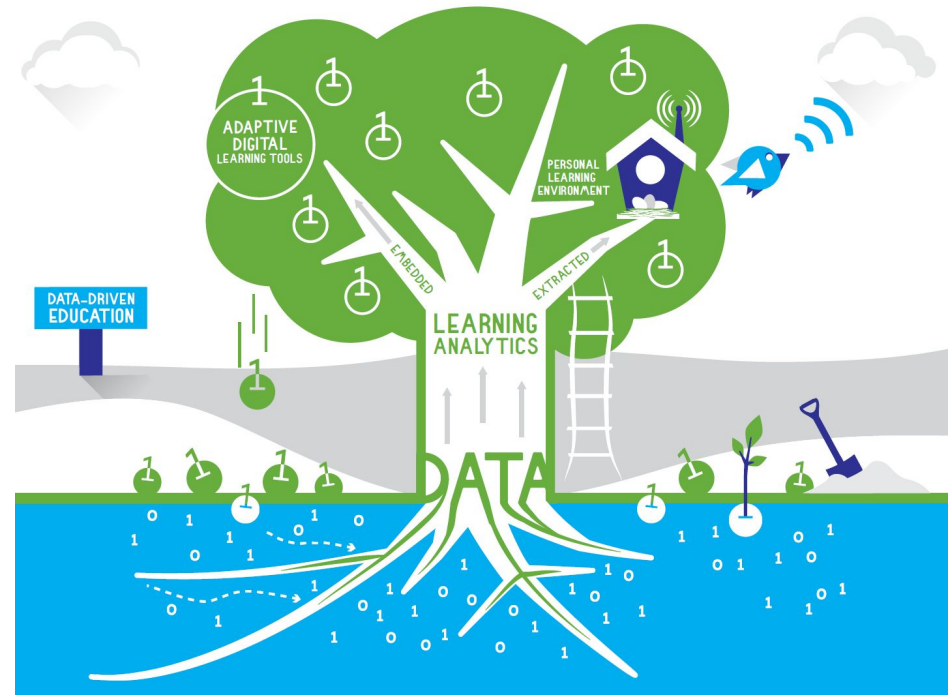
32 min



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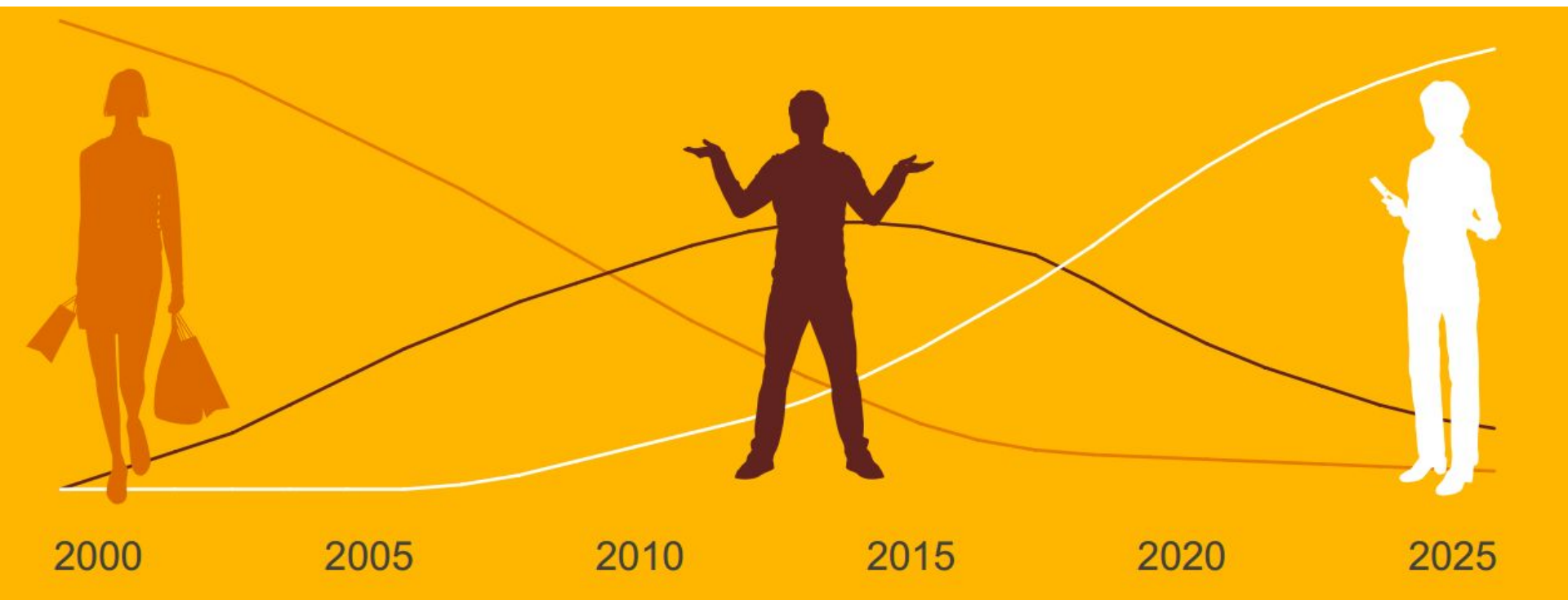
Learning Analytics

The measurement, collection, analysis and reporting of data about learners and their contexts, to optimise learning and the environments in which it occurs



Generational Factors?

- Digital Native
- Digital Settler
- Digital Immigrant
- Digital Omnivore



Are Humans Redundant?

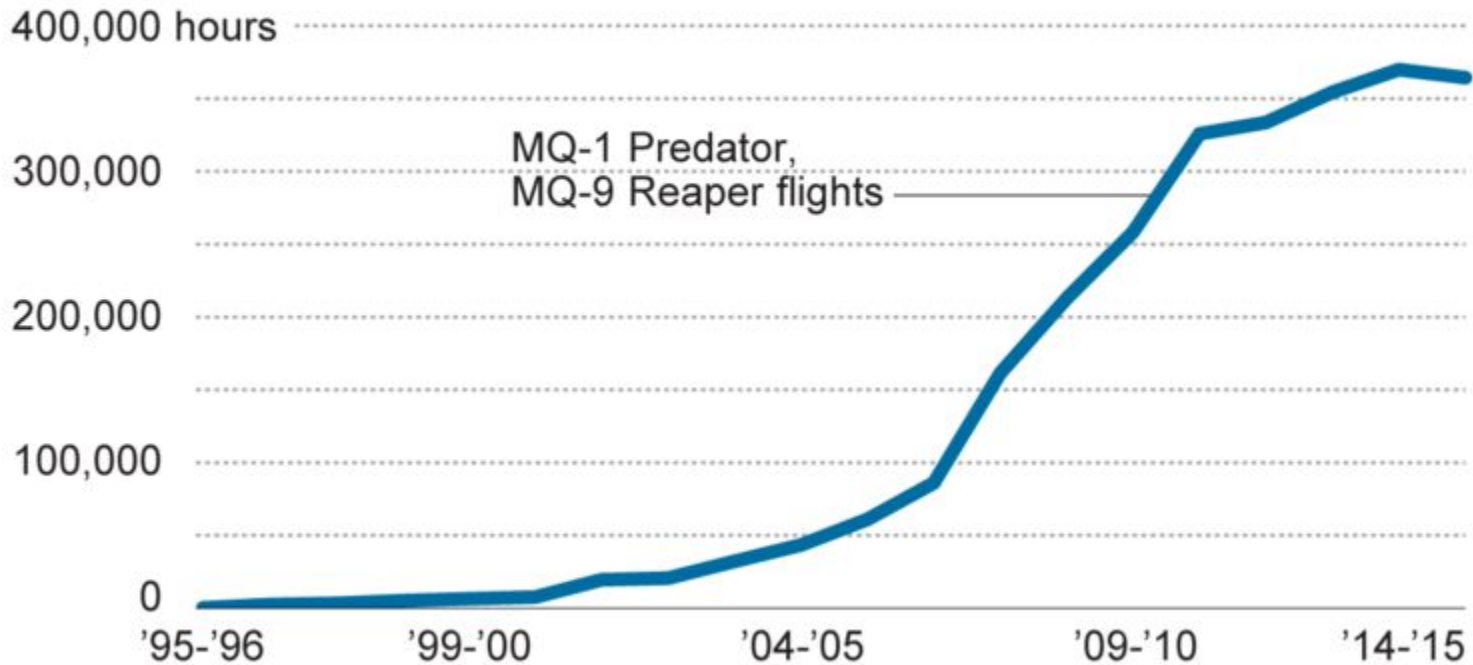
The Rise of Autonomous Systems

Nothing new in the world.. Queen Bee Target Drone – 1930s/40s



US Air Force Drone Missions

Expanding drone operations



Source: Air Force Safety Center

Joe Fox / @latimesgraphics

US Navy X-47B Drone



**August
2014**

**April
2015**



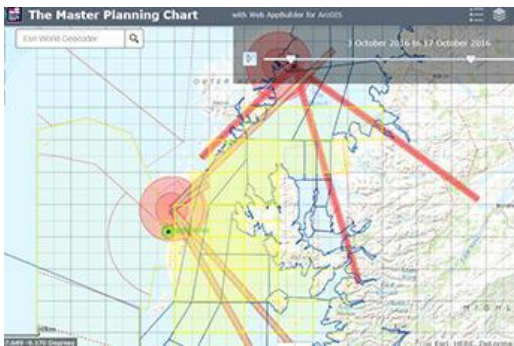
Why Aircraft Carriers? - DARPA Tern Project (2016)



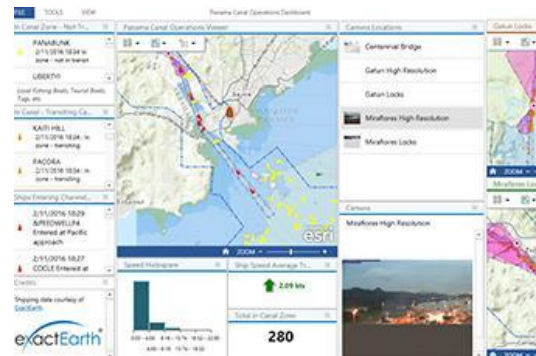
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RN's Unmanned Warrior 2016

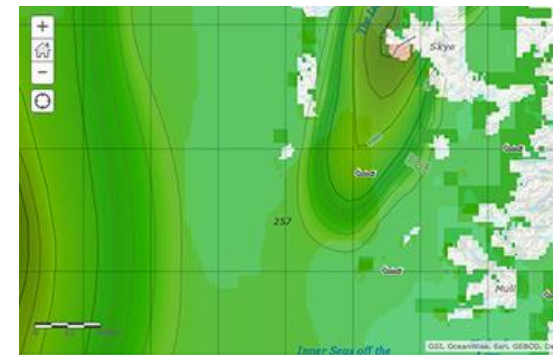
- 50 Unmanned Vehicles Demoed
- “The first RN exercise planned in the Cloud”



Planning



Deployment



Post Deployment



Rolls-Royce Remote-Controlled Ships Concept



theguardian

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[Business](#) > [Rolls-Royce](#)

Rolls-Royce plans remote-controlled ships with no captain or crew on board

British engineering company claims huge cargo carriers will be cheaper, greener and safer than fully manned vessels

Rupert Neate

The Guardian, Friday 30 May 2014 20.12 BST

[Jump to comments \(74\)](#)

A fleet of giant cargo ships, up to almost a quarter of a mile long and wider than a motorway, are to crisscross the world's oceans without a captain or crew on board.

The remote-controlled vessels, which could set sail within the decade, are the latest development in the growing trend for unmanned vehicles, with drone aircraft already flying and Google planning to introduce driverless cars.

Rolls-Royce, the British engineering company developing the ships, claims the unmanned ships will be cheaper, greener and safer than those with a full complement of captain and crew.

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Non-Defence



Games/Simulation Training AI (Google DeepMind)

Google DeepMind's Deep Q-learning

The algorithm will play Atari breakout.

The most important thing to know is that
all the agent is given is sensory input (what
you see on the screen) and it was ordered
to maximize the score on the screen.

The algorithm doesn't know the
rules of the game. It just knows the
score and the sensory input.

2015



2016

The Programs only see the Video Streams

Google DeepMind AI and “Go” (2016)



Artificial intelligence
(AI)

StarCraft II: DeepMind unveils latest game its AI plans to conquer

The AI research firm is teaming up with gaming company Blizzard to take on the real-time strategy game

Alex Hern

@alexhern

Friday 4 November 2016 18.45 GMT



Shares

379

Save for later



A screenshot from StarCraft II, one of the most popular eSports in the world. Photograph: AP

After its success at mastering the ancient Asian boardgame of Go, DeepMind is planning to learn its next game - and it's about as different as it can possibly be.

The London-based AI research firm, a subsidiary of Google, is teaming up with Californian gaming company Blizzard to take on the real-time strategy game StarCraft II.

AI v Humans – Strategy Games

So What?

Computers are being
programmed to learn how to
play games, not how to
play games



Combat AI beats US Air Force's top tactical experts

And it only requires the processing power of a Raspberry Pi.



Andrew Dalton , @dolftown
06.28.16 in [Robots](#)



A new artificial intelligence flight combat system dubbed ALPHA has taken on one of the Air Force's top tactical experts and won. Retired USAF Colonel Gene Lee -- an experienced combat instructor with "considerable fighter aircraft expertise" -- was repeatedly shot down during engagements with ALPHA in a high-fidelity air combat simulation. Lee called his computerized opponent "the most aggressive, responsive, dynamic and credible AI I've seen to date."

Pilot v Machine (2016)

Training Autonomous Systems in Simulation

9T05Google

PLUS ANDROID CHROME/OS GOOGLE APPS ANDROID TV YOUTUBE

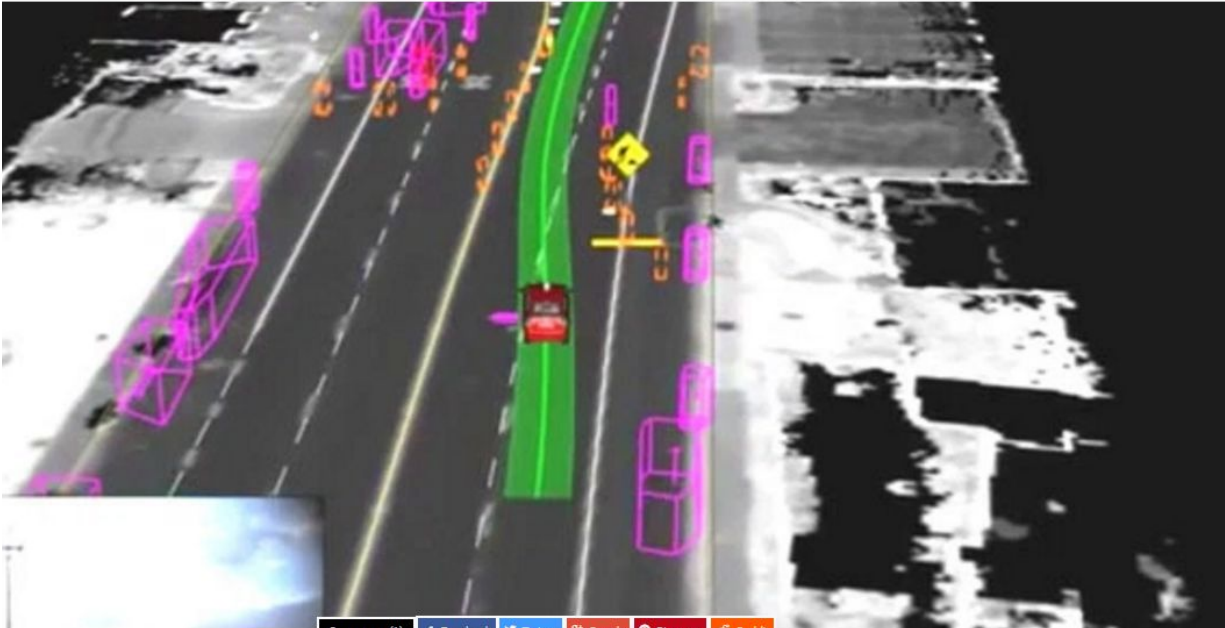
TODAY

GOOG: 764.65 12.65

Google's self-driving cars drive three million miles a day, without leaving the lab

Ben Lovejoy · 11 hours ago · @benlovejoy

SELF-DRIVING CAR X



Comments (1) Facebook Twitter Google+ Pinterest Reddit

Google's self-driving cars have notched up almost 1.5 million miles in autonomous mode since the project began in 2009 – but they drive twice as many miles every single day in the lab. Google's latest monthly report reveals that every software change is tested by using it to simulate driving the entire driving history of the fleet, autonomous and manual.

(Humans) Learning to Drive

- **Passing the driving test takes, on average, 45 hours of lessons**
 - UK Driver and Vehicle Standards Agency
- **The average new driver only feels truly confident after clocking up more than 20,000 miles**
 - Co-operative Insurance Research



Computers still aren't that clever



AI in Games/Simulation can be Bad!



& Humans
might get
even
better...

Neuroscience

US military successfully tests electrical brain stimulation to enhance staff skills

Study paves way for personnel such as drone operators to have electrical pulses sent into their brains to improve effectiveness in high pressure situations

Ian Sample Science editor

@iansample

Monday 7 November 2016 17.48 GMT



3,346 329



Performance of military personnel can slump if the demands of the job become too intense. The study found that electrical brain stimulation can stave off the drop in performance. Photograph: Christian Science Monitor/Getty

US military scientists have used electrical brain stimulators to enhance mental skills of staff, in research that aims to boost the performance of air crews, drone operators and others in the armed forces' most demanding roles.

What About Simulation and Decision Support/C2?

A Metaphor for the Military

Training



Mission

Preparation



Analysis



Operations



Decision Making and Simulation

- Could simulation provide the channel and destination for all military operational data?
- Could such a simulation also support a combined C2/simulation application(s), providing shared situational awareness and improved visualisation?

Ender's Game - 1985



HDWallpapersImages.com

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Ender's Game Film - 2013



THINKE

Takeaways

A neon sign with the word 'INDIAN' in green and 'CHINESE' in red. The letters are thick and outlined with neon tubing. The sign is set against a dark background.

INDIAN
CHINESE

Modern Simulation is Adaptable and can Support a Wide Range of Training and Mission Rehearsal

- **But, simulation capabilities should be managed on an enterprise level, and not stovepiped, to realise the full potential**

Advances in Artificial Intelligence are Unceasing and Simulation has a Significant Role to Play

- **But, it AI is still very challenging and success depends on where it is applied**
- **We must work towards the optimum human/machine blend**

People will Remain Our Most Adaptable Capability



Questions?

