

13 May 2021

**SMi 4th Annual Unmanned
Maritime Systems
Technology Conference**

Digital Sailor

Andy Fawkes



THINKE



The Presenter

Andy Fawkes
FIMechE

Twitter
@andyfawkes1

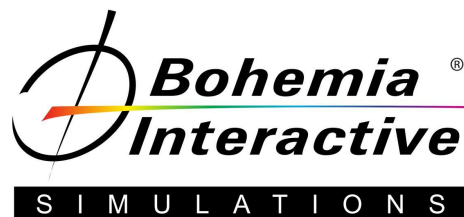
LinkedIn
andyfawkes

email
andy.fawkes@thinke.co.uk

Before



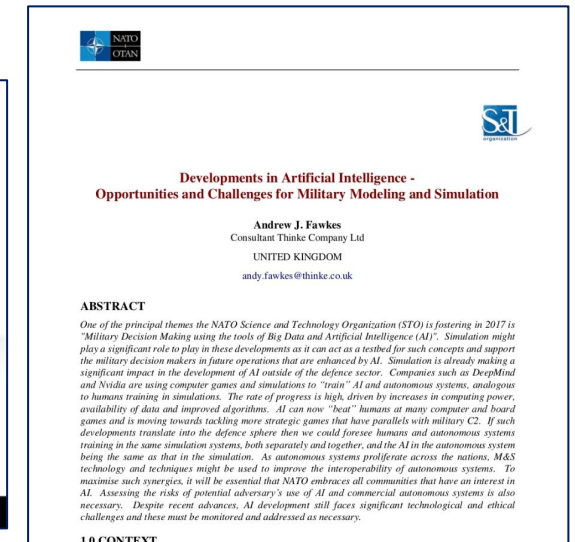
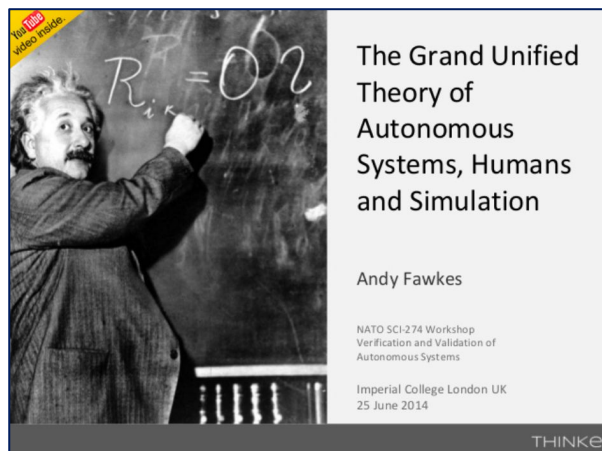
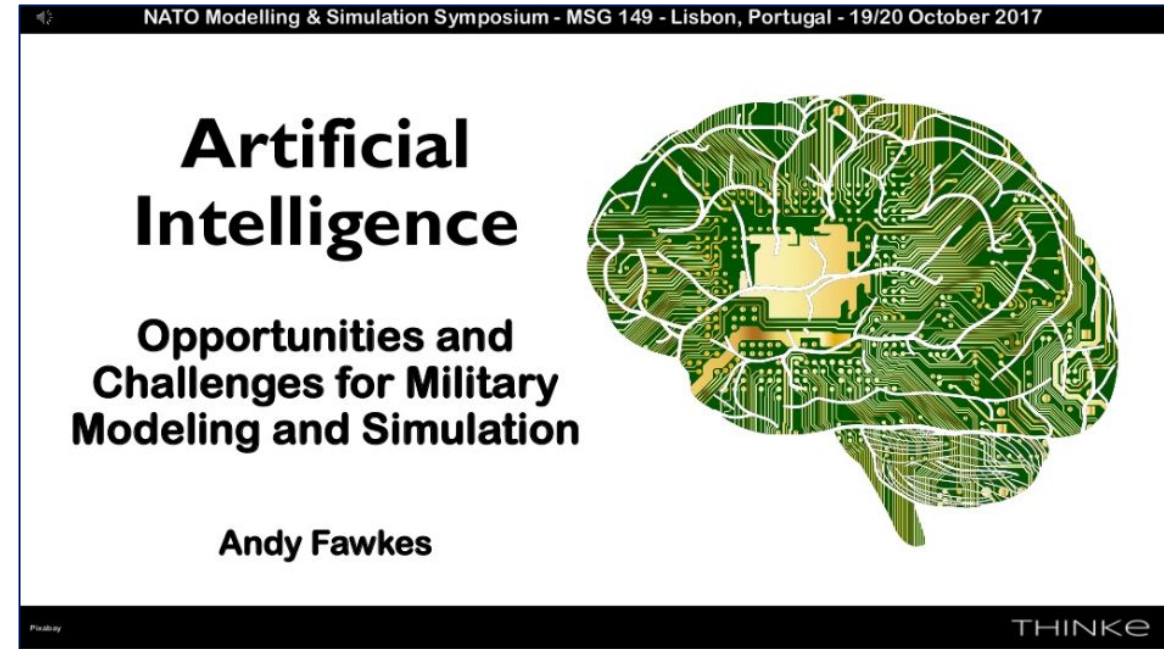
Ministry
of Defence



Now

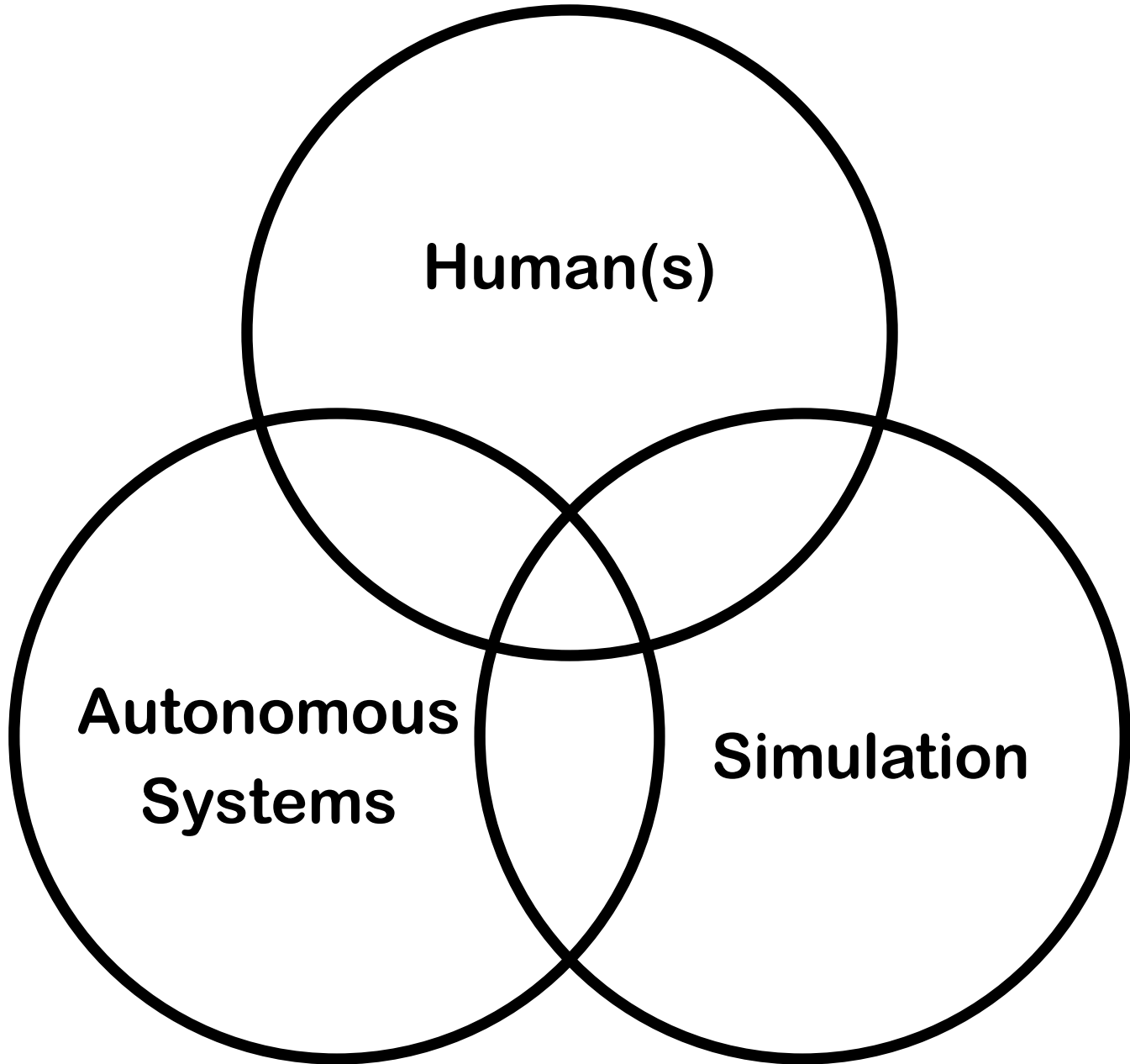


Earlier Presentations/Publications

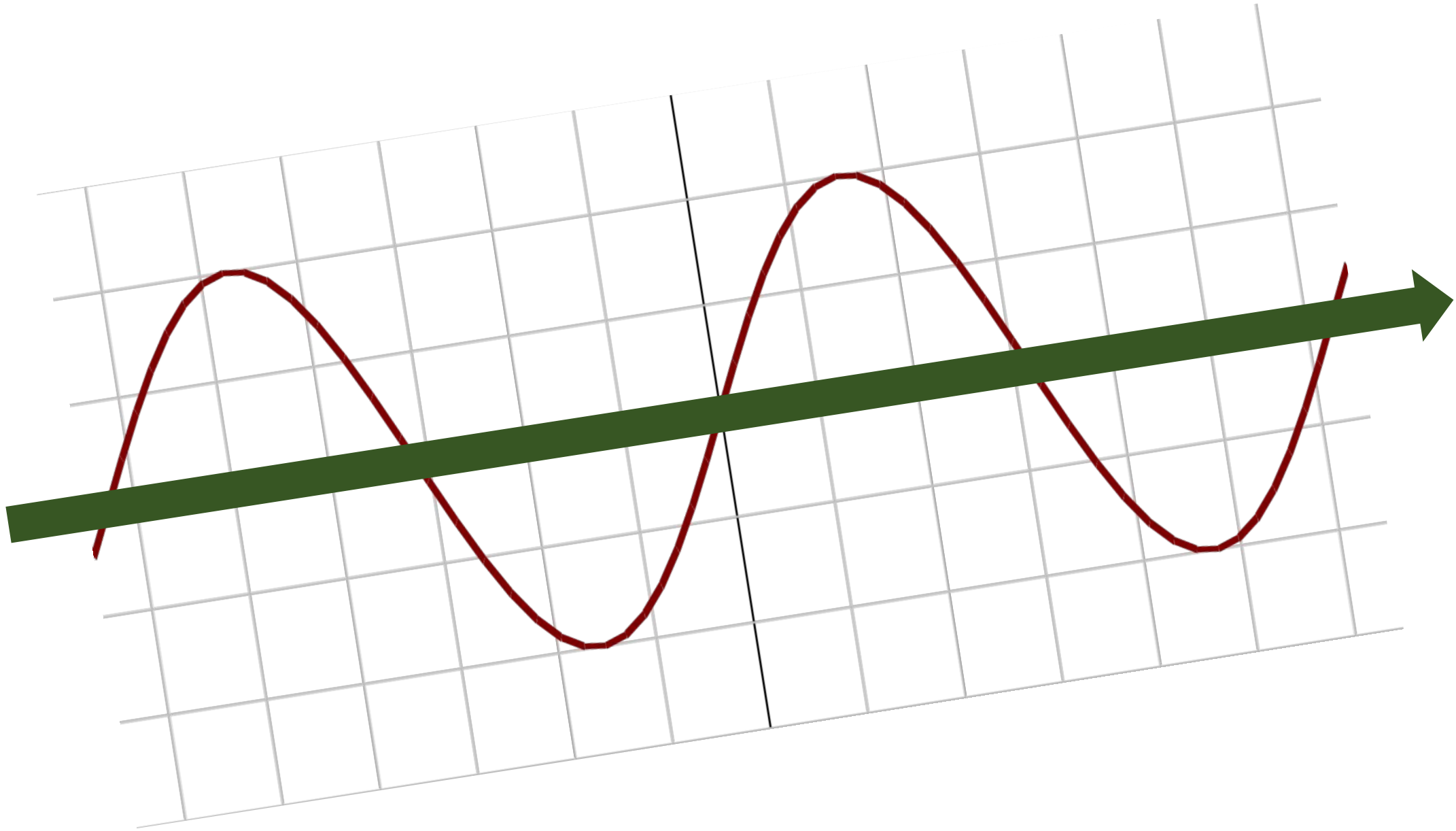


THINKER

Harmony



My Feelings on Unmanned Systems/Automation



Outline

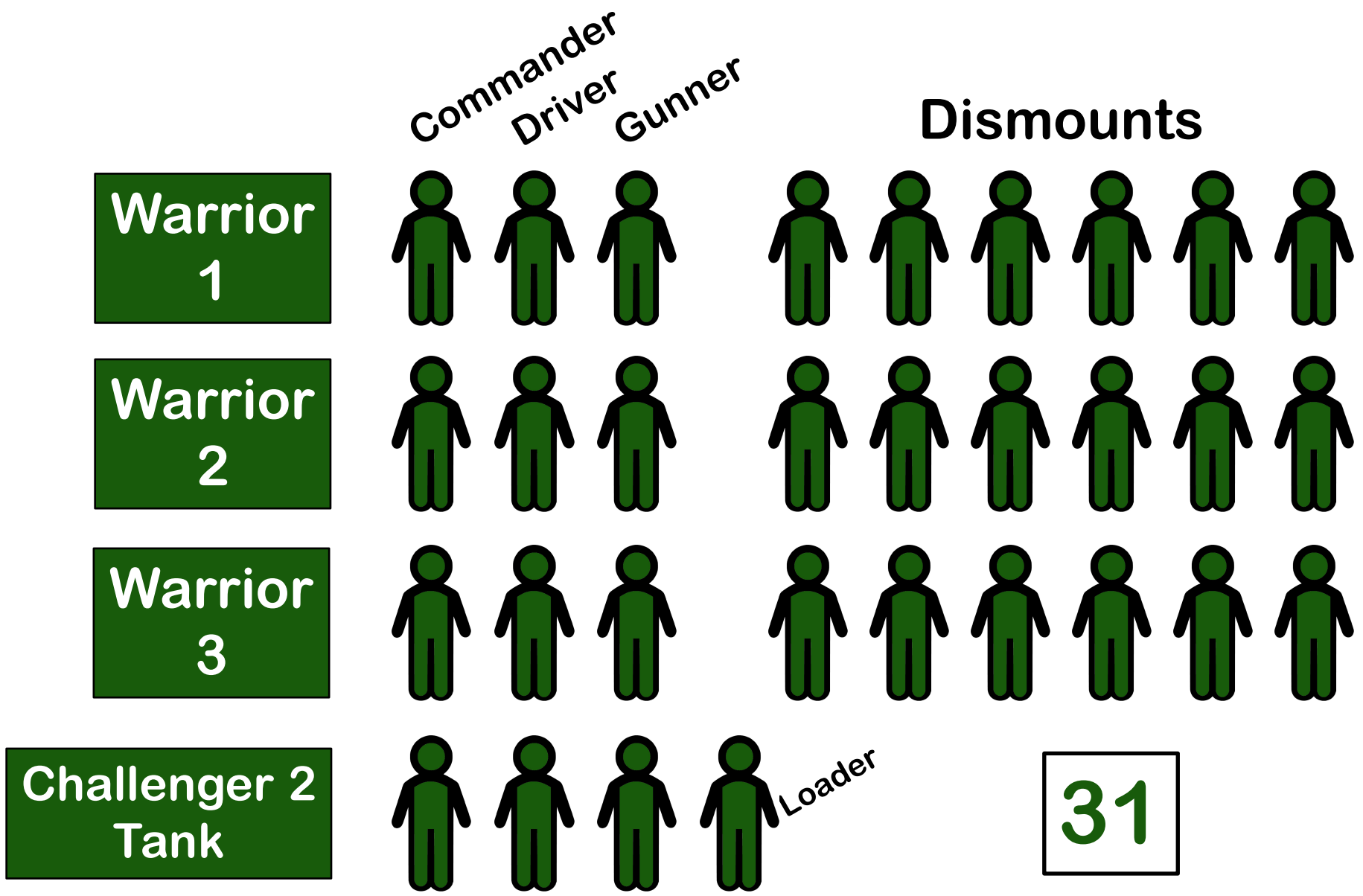
- **First Thoughts**
- **It's a Trend... The Good, the Bad, and the Ugly**
- **New Sailors, New Human/Machine Interfaces?**
- **Simulation, Gaming and Remote/Autonomous Systems**
- **Final Thoughts**

First Thoughts

Battlesbury Barracks, Warminster UK



VRLT Main Training Audience





War is chaotic

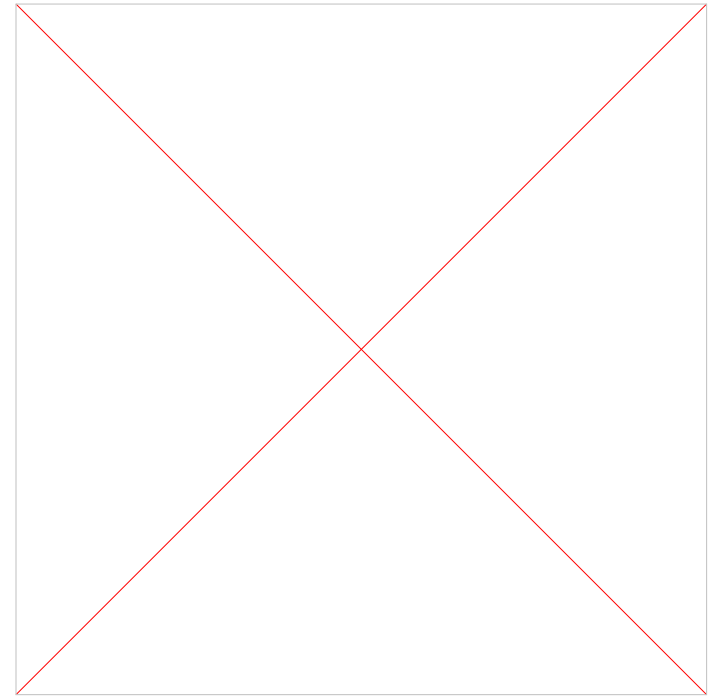
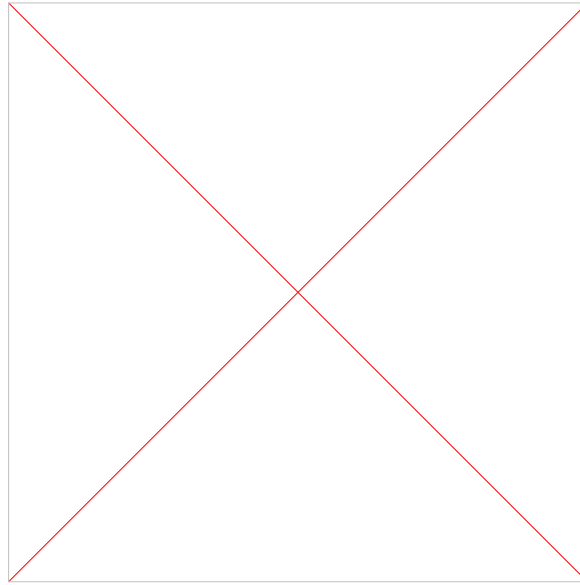
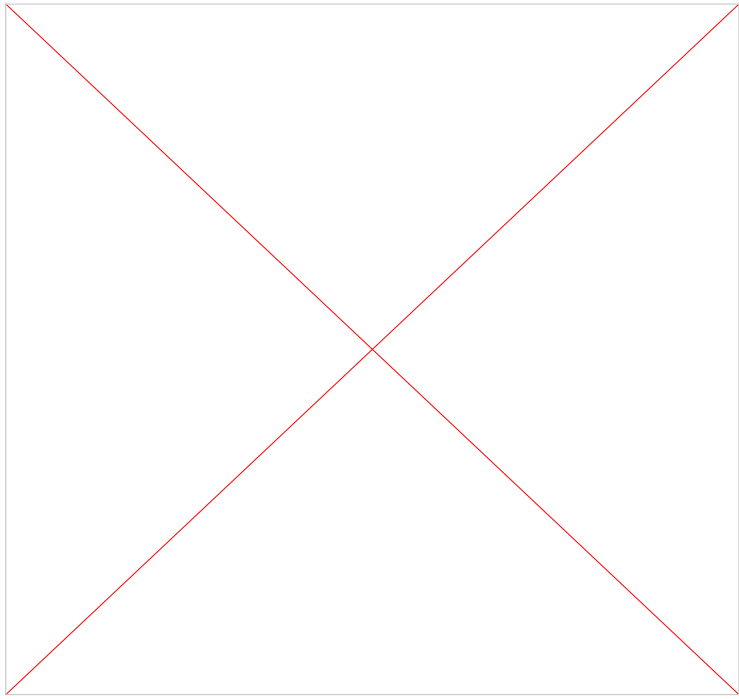
**No battle plan
withstands
contact with
the enemy**

**Humans are
Very
Adaptable**

Why Replace the Human?

- Dull
- Dirty
- Dangerous
- Dear

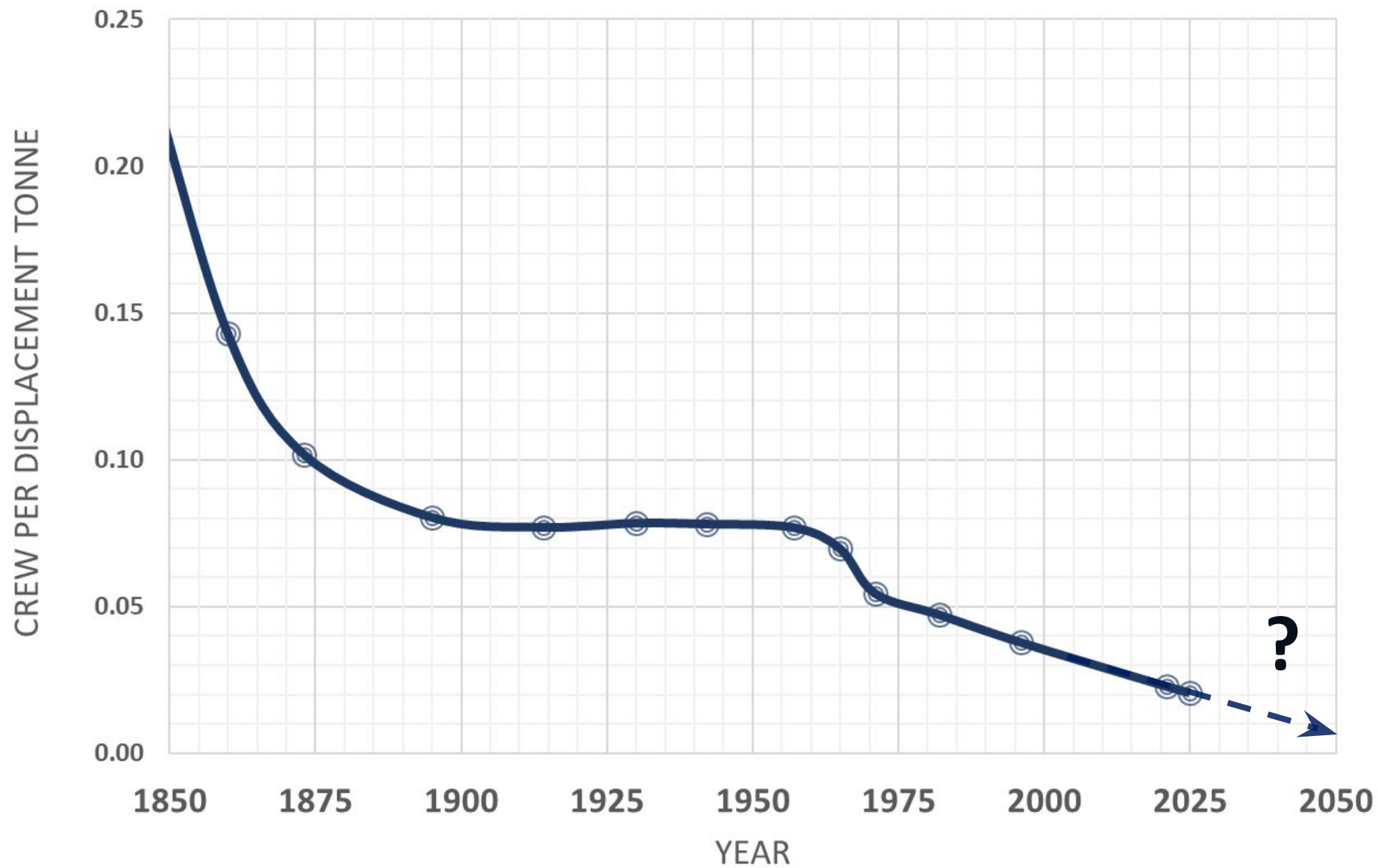
Autonomy and Communications



It's a Trend...

**(The Good, the Bad, and
the Ugly)**

RN Frigates – Crew per Displacement Tonne





Remote Pilots



Radio Controlled "Queen Bee" (1936)

Sea Cat Anti Air Missile (1963)



Some Military Autonomous Systems



**US Navy
X-47B**

**US F-18 &
103 Drone
Swarm**



**US Army
Manned-Un
manned
Teaming
(MUM-T)**

**US Navy
Autonomous
Craft**



Boeing MQ-25 Stingray (Aerial Refueling Drone) – Dec 2020



NASA's Ingenuity Helicopter – First Flight – 19 April 2021

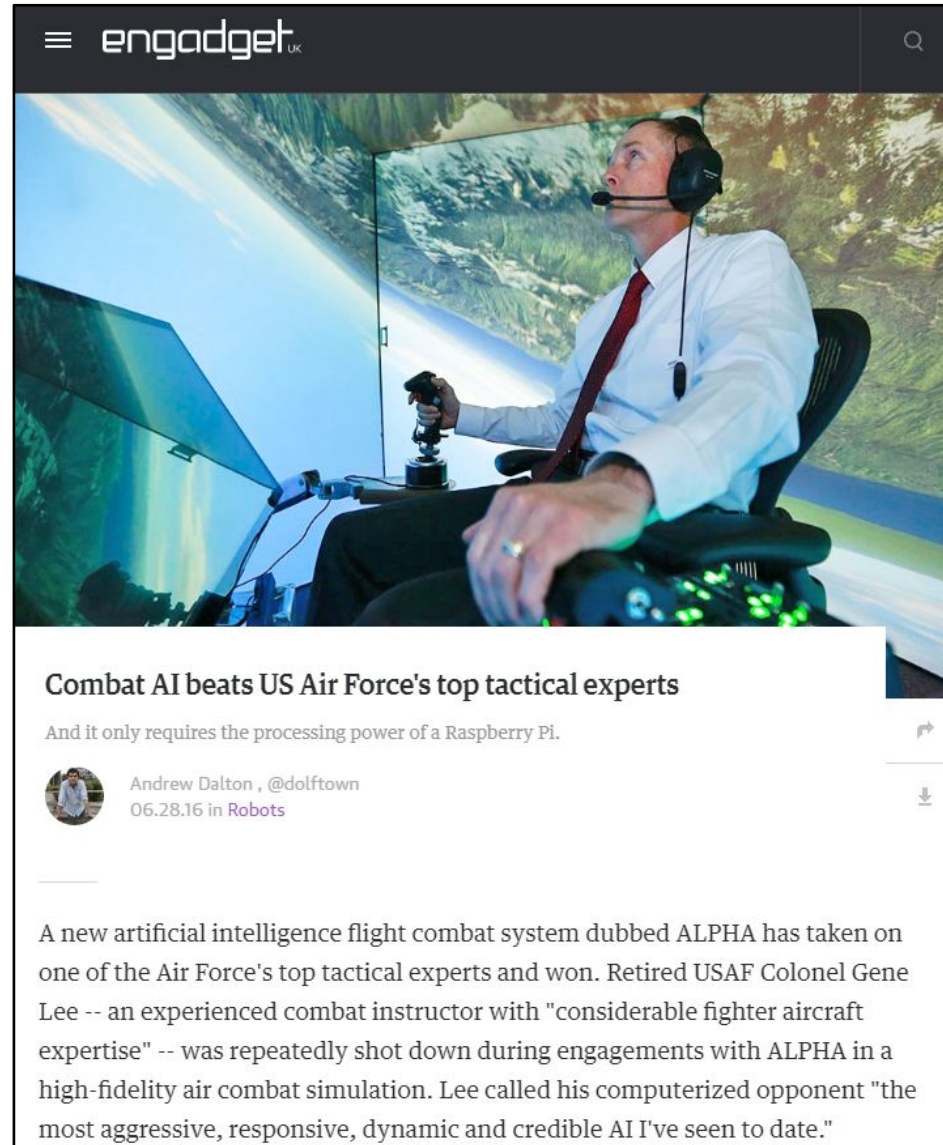


Live Video

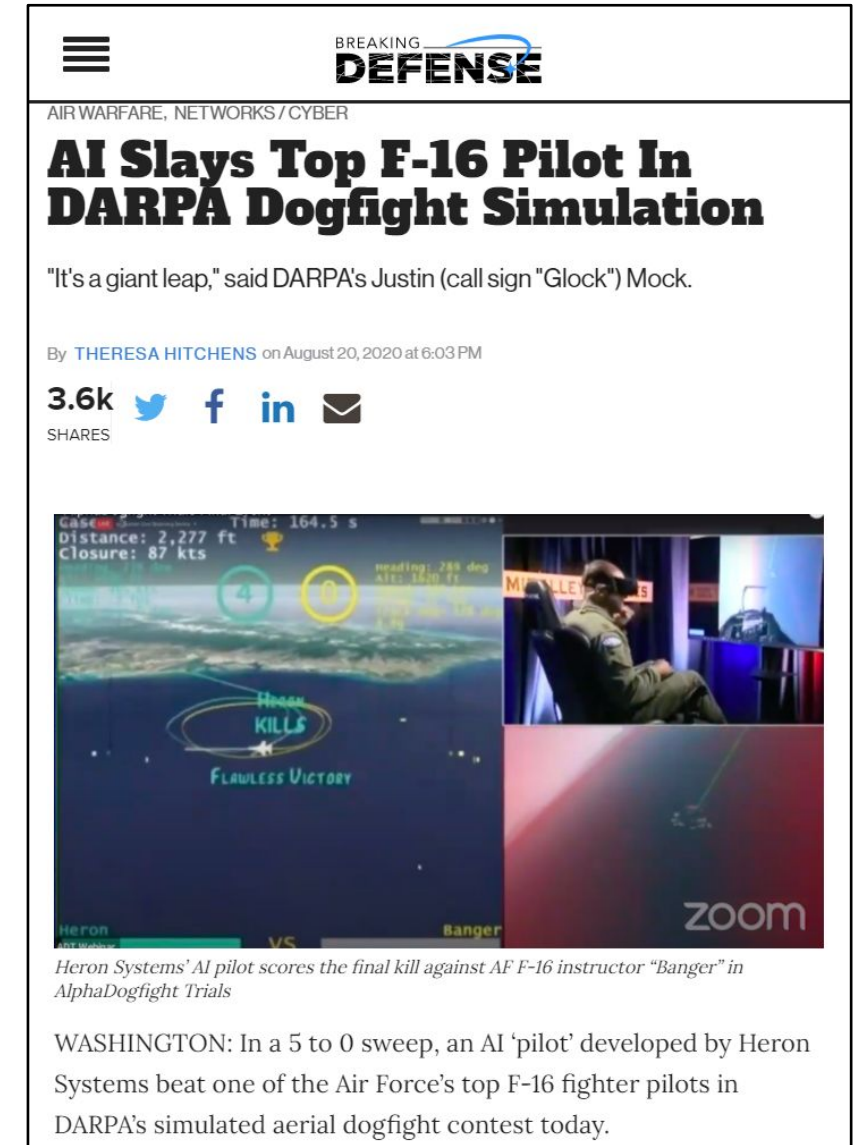


From Telemetry Data

Redundant Pilots?



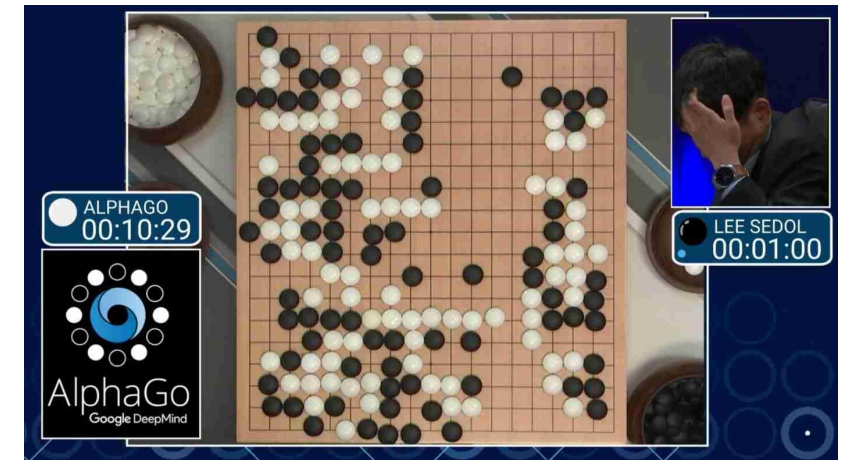
2016



2020

“AlphaGo” (2016) & “AlphaGo Zero” (2017)

- AlphaGo beats top Human Go Player
- The next incarnation was “AlphaGo Zero”, with a new neural net design
 - Trained in 3 days, no human intervention except Go rules
 - AlphaGo Zero beats AlphaGo – 100 to 0



Google DeepMind 2019

THE VERGE

TECH

REVIEWS

SCIENCE

CREATORS

ENTERTAINMENT

VIDEO

MORE

f

t

📡

👤

🔍

GAMING

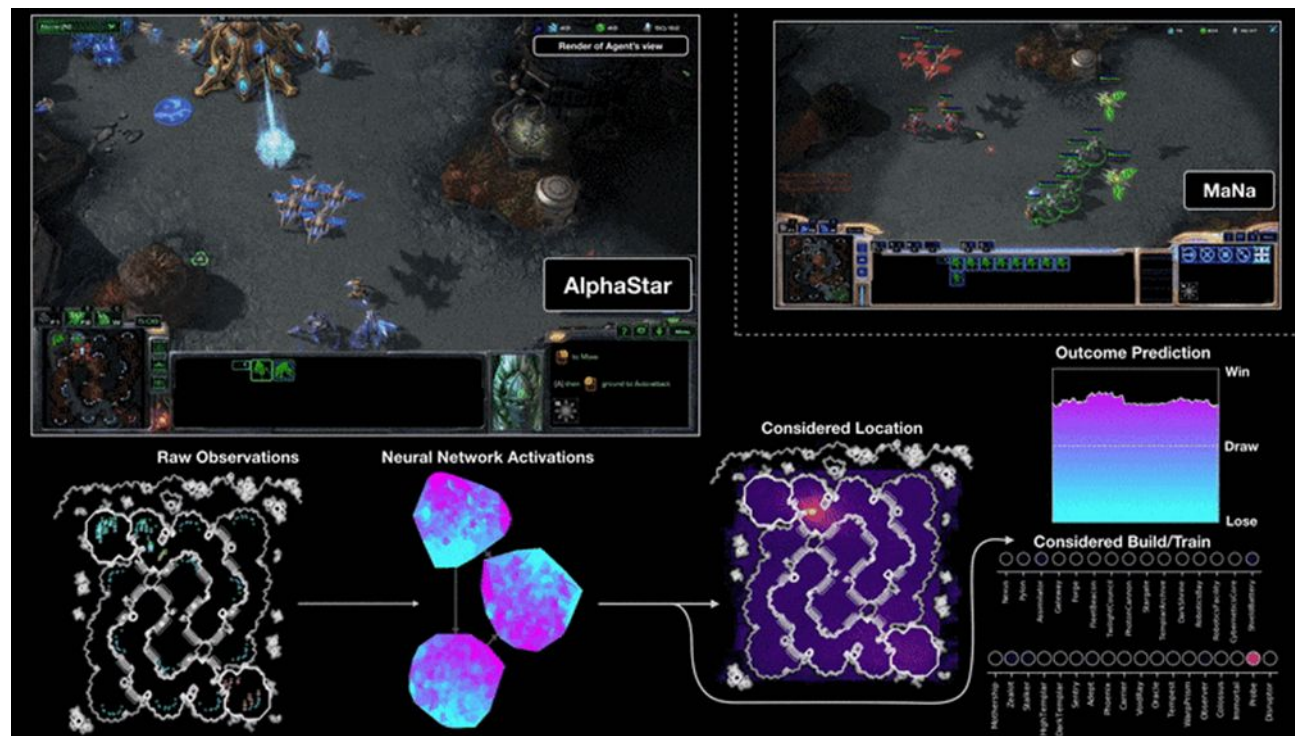
TECH

ARTIFICIAL INTELLIGENCE

DeepMind's StarCraft 2 AI is now better than 99.8 percent of all human players

AlphaStar is now grandmaster level in the real-time strategy game

By Nick Statt | @nickstatt | Oct 30, 2019, 2:00pm EDT



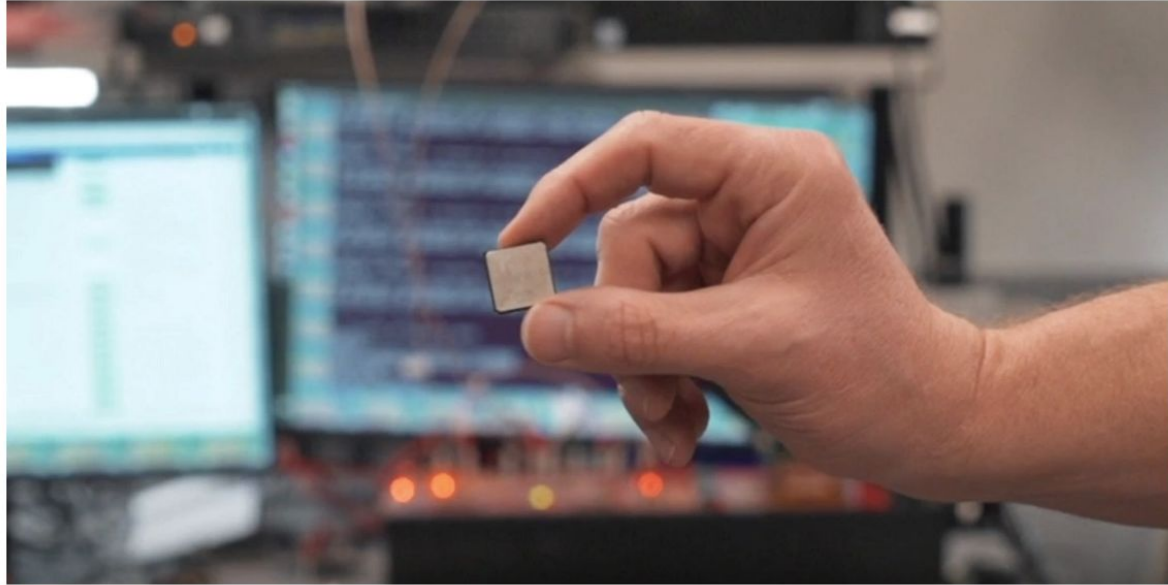
Edge AI Computing

Mythic raises \$70M to disrupt AI chips with analog and flash components

VB venturebeat.com/2021/05/11/mythic-raises-70m-to-disrupt-ai-chips-with-analog-and-flash-components

Dean Takahashi

May 11, 2021



Join Transform 2021 this July 12-16. Register for the AI event of the year.

Mythic has raised \$70 million to fund the analog-based AI processors it plans to launch later this year.

Mythic has spent nine years coming up with a patented, potentially disruptive way to compete with other makers of artificial intelligence chips. The company emphasizes energy efficiency and lower cost with its design that focuses on analog technology integrated with dense flash memory, CEO Mike Henry said in an interview with VentureBeat.

Edge AI chipset developer Sima.ai raises \$80M

VB venturebeat.com/2021/05/11/edge-ai-chipset-developer-sima-ai-raises-80m

Kyle Wiggers

May 11, 2021



Join Transform 2021 this July 12-16. Register for the AI event of the year.

Sima.ai, a company developing embedded edge hardware for machine learning applications, today announced that it raised \$80 million in a series B round led by Fidelity Management & Research Company. The startup says that the funds will be used to commercialize its first-generation system-on-a-chip product, as well as to jumpstart development of its second-generation product's architecture and supports Sima.ai's go-to-market, customer success, and hiring initiatives globally.

Data Misjudgements



Google Street View

BeamNG Vehicle AI (2021)



Monitoring Systems



The Register

{* INTERNET OF THINGS *}

Army Watchkeeper drone flopped into tree because crew were gazing backwards

Live footage of runway and grass verge more compelling than actual flight instruments

Thu 29 Aug 2019 // 10:11 UTC

98 GOT TIPS?

Gareth Corfield BIO EMAIL TWITTER

SHARE

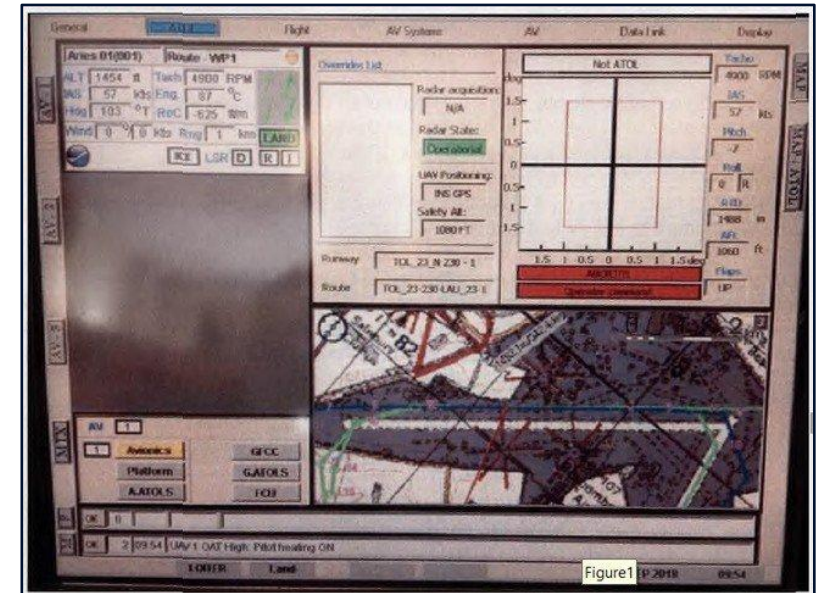
The latest British Army Watchkeeper drone crash happened because its crew became fixated on live footage from an onboard camera instead of their instruments, a Ministry of Defence report has revealed.

An internal Defence Accident Investigation Branch (DAIB) report detailed why the semi-autonomous aircraft, tail number WK050 and flown on the day by two Royal Artillery operators, crashed in June 2018.

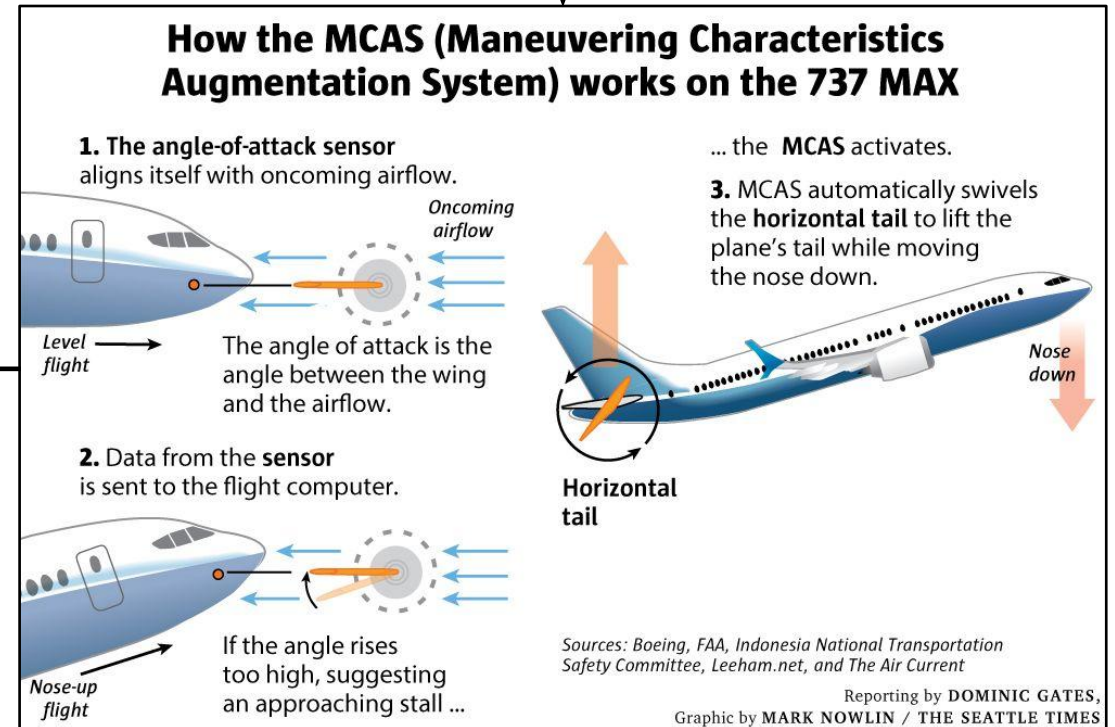
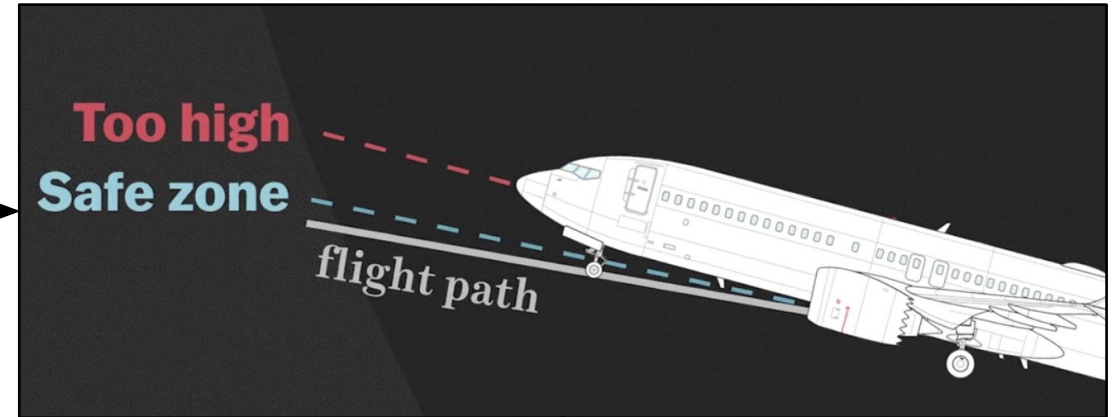
The report, dated February 2019, was [published online](#) by the MoD after the BBC made a Freedom of Information request for it, leading to [news reports](#) over the past few weeks.

WK050 flopped into a tree just beyond the runway of Aberporth airport on the Welsh coast after its Army operators, under the supervision of contractors from a Thales joint venture company, cut its throttle immediately after the drone had landed and lifted off again.

"Had no action been taken, the [Watchkeeper] would have completed its automatic go-around from which it could have been commanded to conduct a further approach," said the DAIB in its Safety Investigation Report, which was written by a major and a Warrant Officer 1 (WO1).

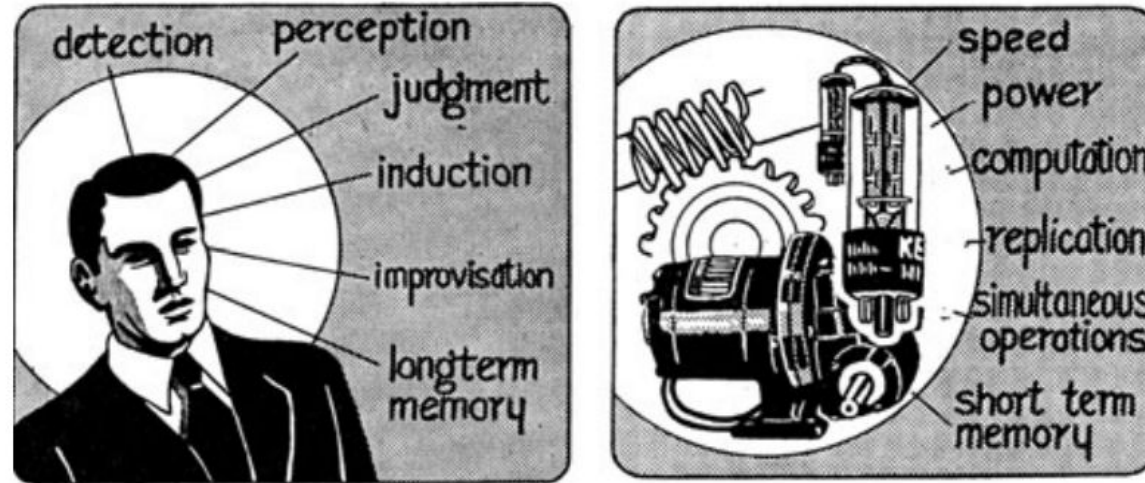


Boeing 737 MAX – Sensors, Automation & Humans



Paul M Fitts (1951)

Human Engineering for an Effective Air Navigation and Traffic Control System

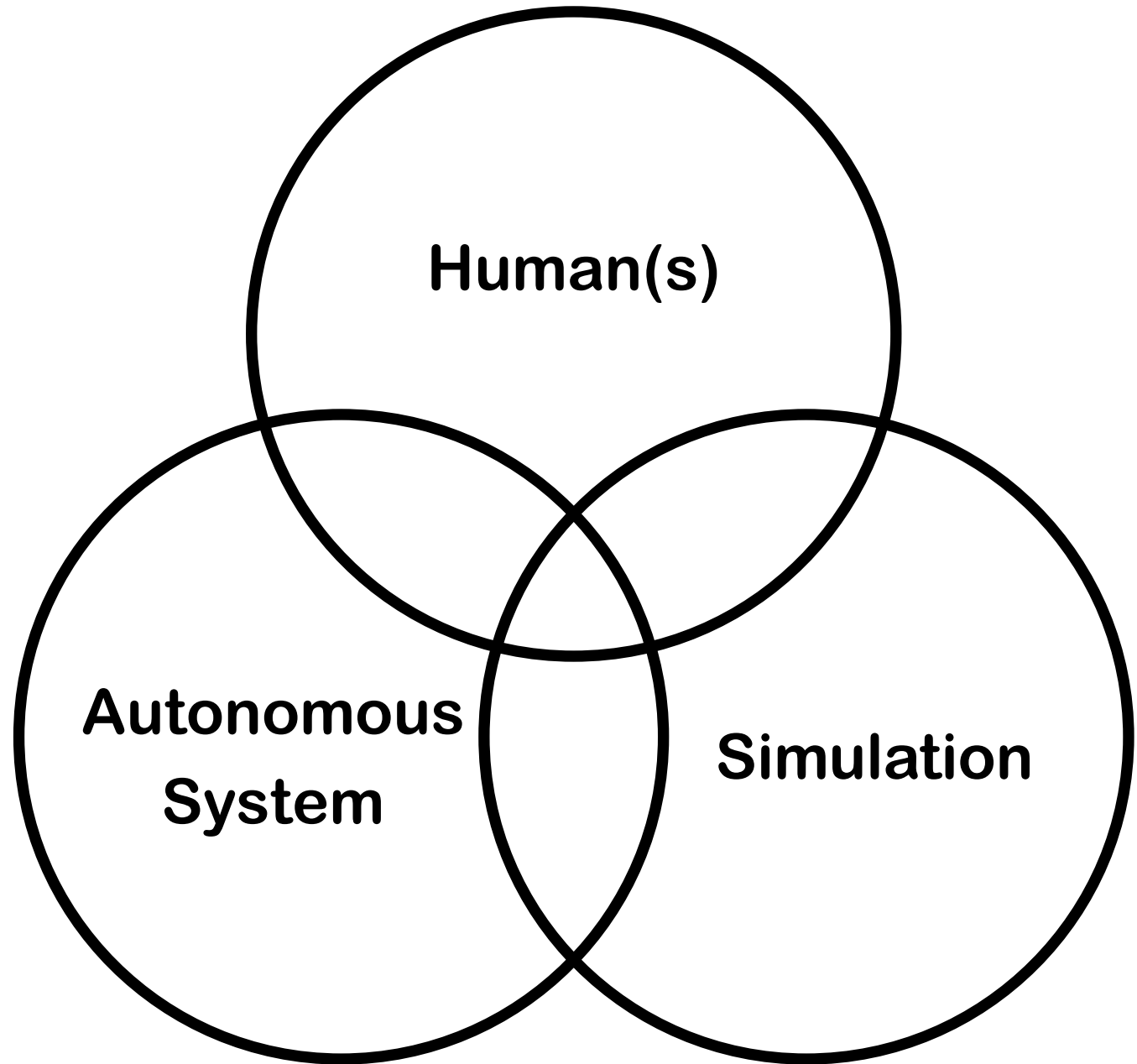


- “great caution be exercised in assuming that men can successfully monitor complex automatic machines and take over if the machines break down”
- “engineers should seriously consider systems in which machines would monitor men and prevent them from making dangerous

**Test & Train
Test & Train
Test & Train**

.....

Test & Train



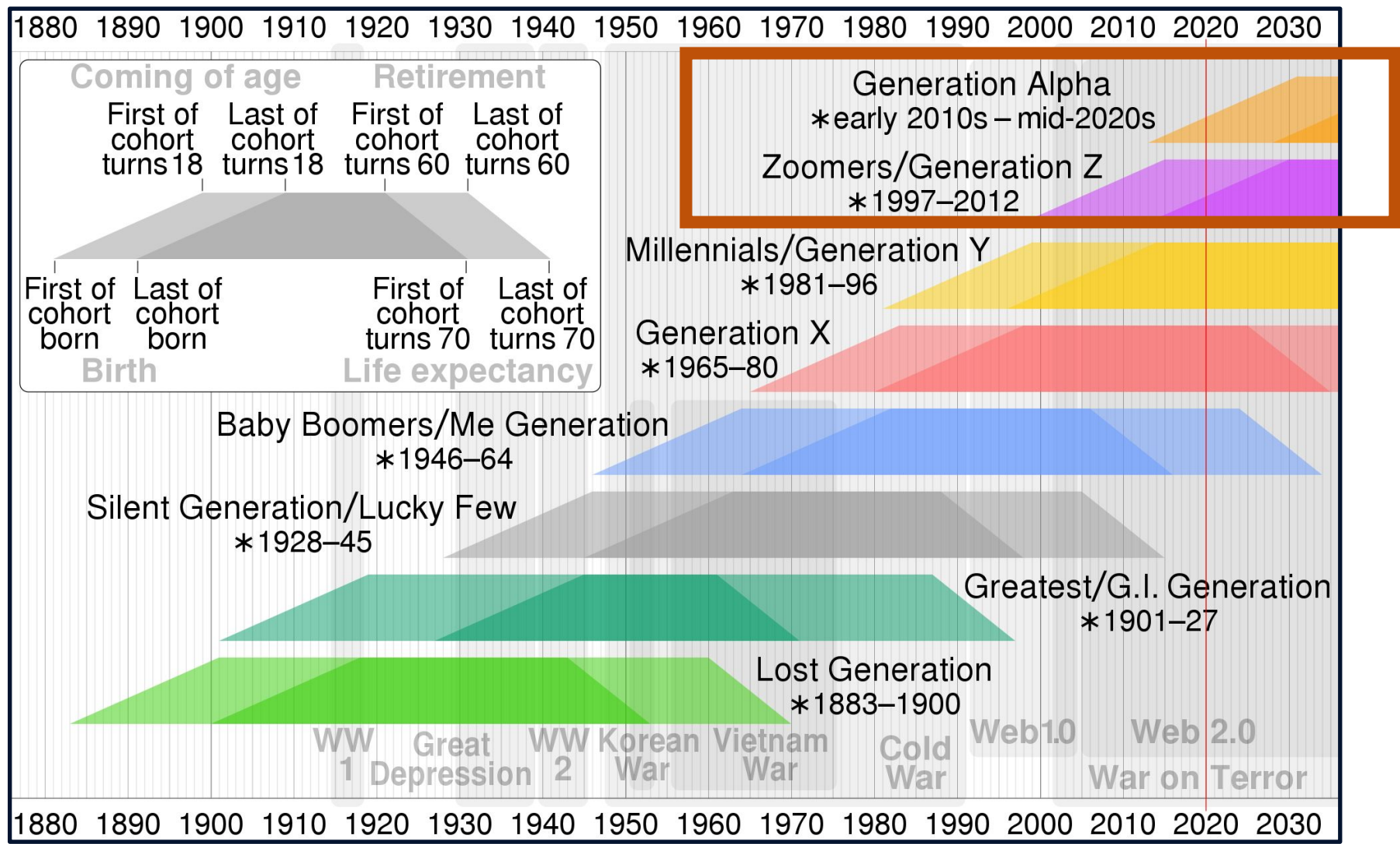
New Sailors, New Human/Machine Interfaces?

Sailors of the Future?



- Who will they be?
- What will they do?
- Where will they be?
- How will they train?
- Will we need them?

The Next Workforce



Z
α

RN Age Distribution



**50% of the RN is < 30
and 80% < 40**

**Broadly, 2/3rds of the RN
now are Digital Natives
and 90% by 2030**

UK REGULAR FORCES BY AGE

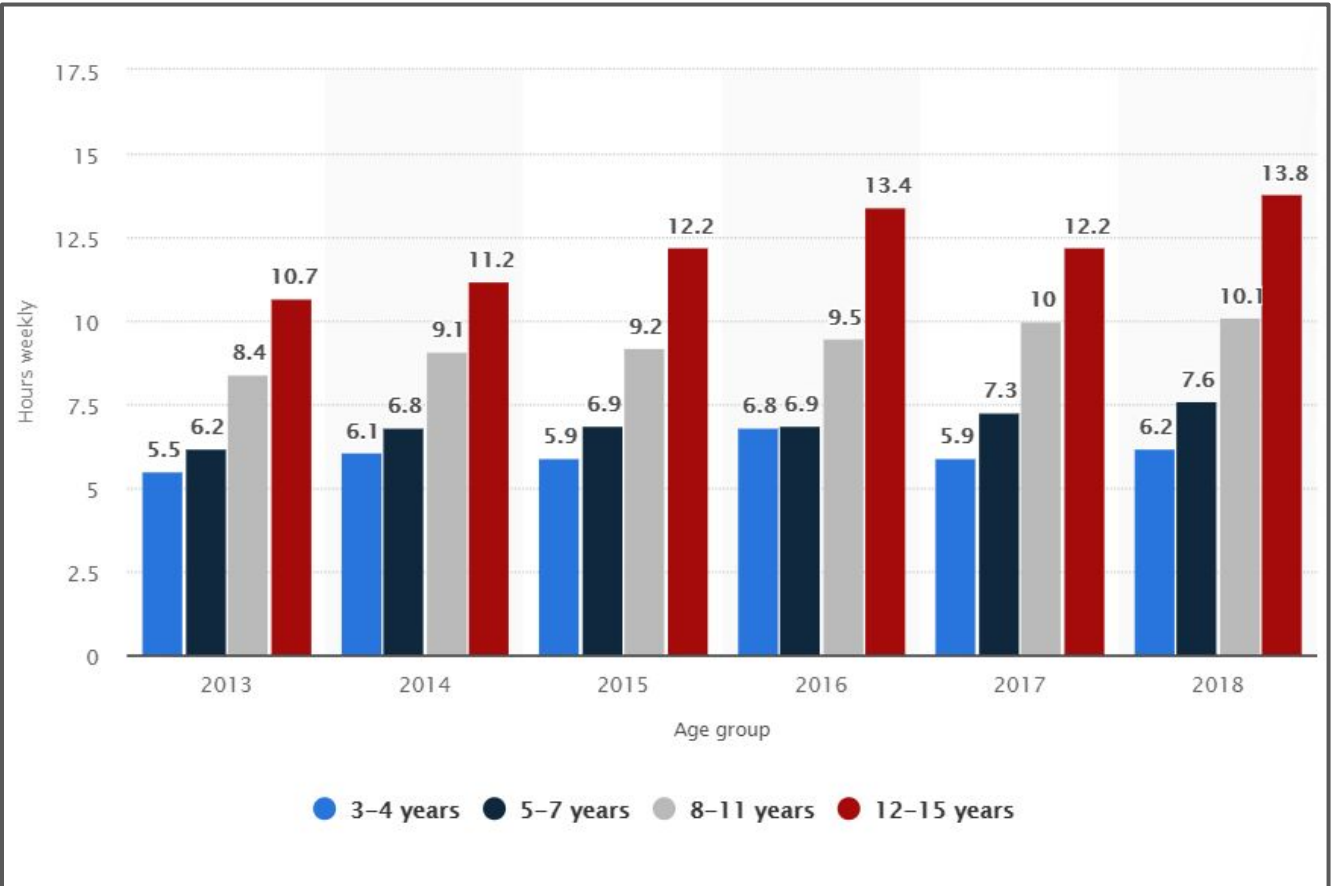
Full-time trained and untrained personnel, at 1 April 2018

	Army Service	Naval Service	RAF Service	All services
Under 18-24	21,720	7,440	5,530	34,710
Under 18	1,630	230	160	2,030
18-24	20,090	7,210	5,370	32,680
25-34	34,770	13,550	13,220	61,530
25-29	19,250	7,540	6,830	33,610
30-34	15,520	6,010	6,390	27,920
35-44	19,640	7,490	9,330	36,470
35-39	12,760	4,650	5,790	23,210
40-44	6,880	2,840	3,540	13,260
45 and over	4,970	4,010	4,860	13,850
45-49	3,270	2,360	2,790	8,420
50-54	1,510	1,390	1,740	4,640
55-59	190	250	330	770
60 and over	~	10	~	20



93% of Children Play Video Games

Children's Commissioner for England (2019)



Air Chief Marshal Sir Stephen Hillier Jan 18

**“teenagers playing on
their Xbox at home
should take their
gaming to the next
level and join the RAF
to operate real
drones”**

MailOnline

News

Home News U.S. Sport TV&Showbiz Australia Femail Health Science Money Video Travel DailyMailTV

Latest Headlines Royal Family News World News Arts Headlines France Pictures Most read Wires Discounts

Login

Join the RAF for the real thing, Xbox teenagers are told: Head of the air force says young gamers should take it to the next level by operating drones

- Air Chief Marshal Sir Stephen Hillier wants more young people to join the RAF
- The service will be celebrating their 100th anniversary with events this year
- Among the major events planned is a flypast along the Mall before the Queen
- RAF chiefs hope a display of military might could provide a boost to recruitment



By LARISA BROWN FOR THE DAILY MAIL

PUBLISHED: 00:32, 12 January 2018 | UPDATED: 00:53, 12 January 2018



Share



387
shares

194
View comments

Teenagers playing on their Xbox at home should take their gaming to the next level and join the RAF to operate real drones, the head of the air force said yesterday.

Air Chief Marshal Sir Stephen Hillier said the RAF's next 100 years will see a huge shift towards unmanned flying machines as he outlined plans for centenary celebrations.

Human Machine Interfaces



XR

eXtended Reality (XR)

Reality	Augmented Reality	Mixed Reality	Virtual Reality
The real world	Information layered over vision	Blend of real & digital information to enhance reality	Fully virtual world
			

VR-Based Training at Scale (2019)



- 18,500 Lufthansa cabin crew practice safety-related training required by the authorities in 18 VR cabins located in Frankfurt and Munich

Mixed Reality in Operations

Microsoft is supplying 120,000 HoloLens-based headsets to the US Army

The contract could be worth up to \$21.88 billion over 10 years

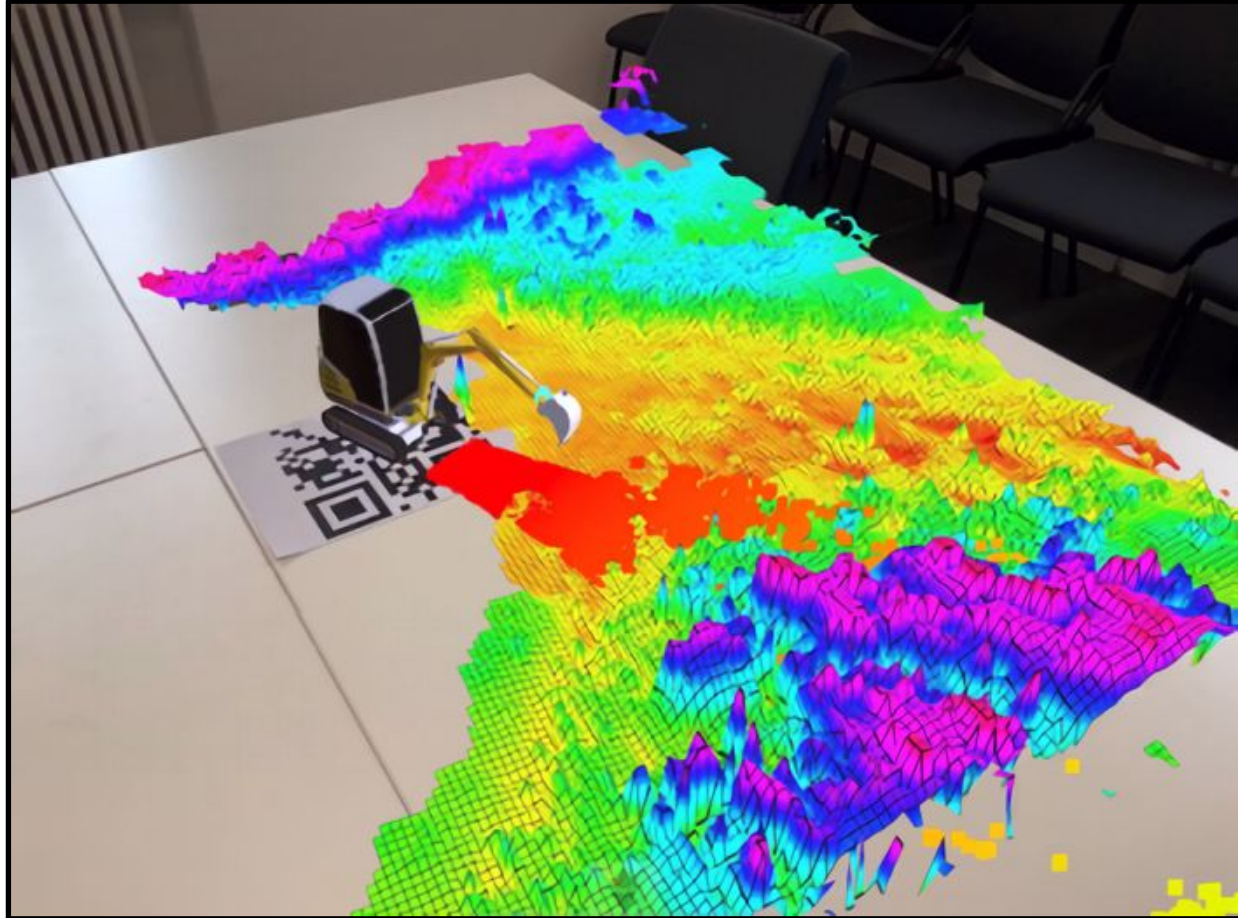
By Tom Warren and Sean Hollister | Mar 31, 2021, 4:11pm EDT



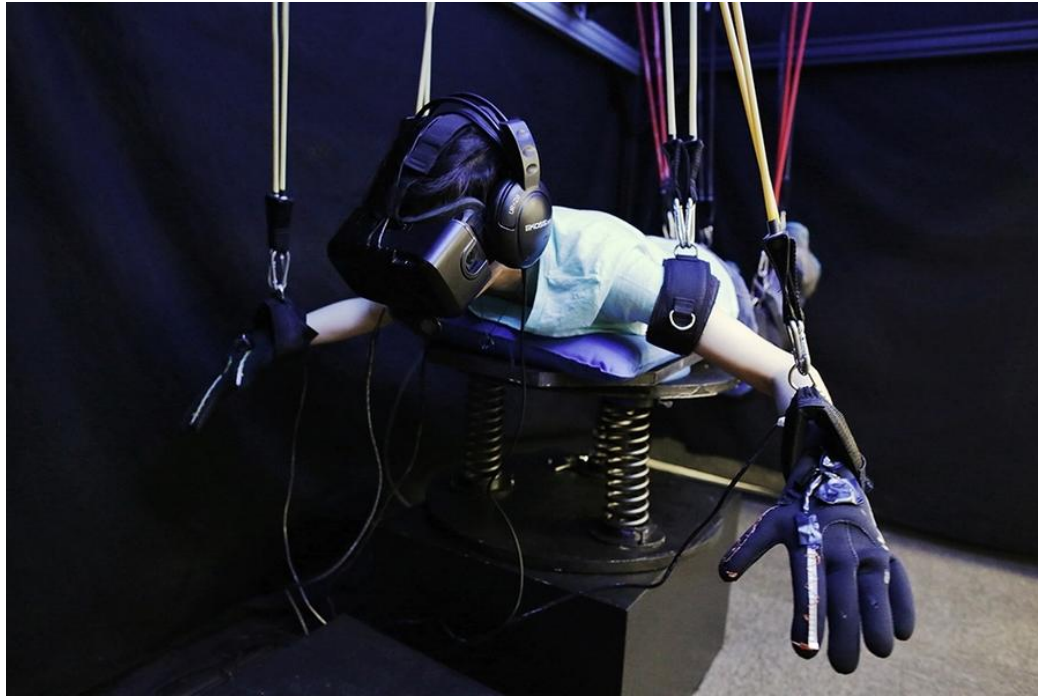
Image: US Army

Microsoft has won a contract to supply the US Army with HoloLens-based headsets. The contract could be worth up to \$21.88 billion over 10 years, and [CNBC reports](#) that it will involve Microsoft supplying 120,000 headsets. The software maker has been working closely with the Army since 2018, and soldiers have been testing the Integrated Visual Augmentation System (IVAS) headsets over the past two years. These devices combine high-resolution night, thermal, and soldier-borne sensors into a heads-up display.

See What the Machine Sees Through AR (Augmented Reality)



VR and Divers?



MIT Media Lab (2016)



NASA Astronaut Trainer (2018)

Voice Controlled Autonomous Systems

UK

www.cervusdefence.com/case-studies/exploring-voice-controlled-autonomous-systems



Voice Control is Fast, Intuitive, Powerful



Dramatically speeds up interfaces and cycle times

Adapts to language in the context of the situation

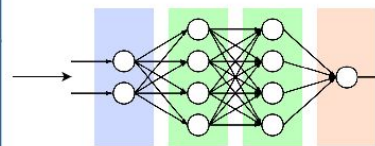
Control of both micro-movements and macro-tactics



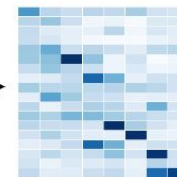
Operator / Mic



Voice processing
neural network



Encoded action / SQF



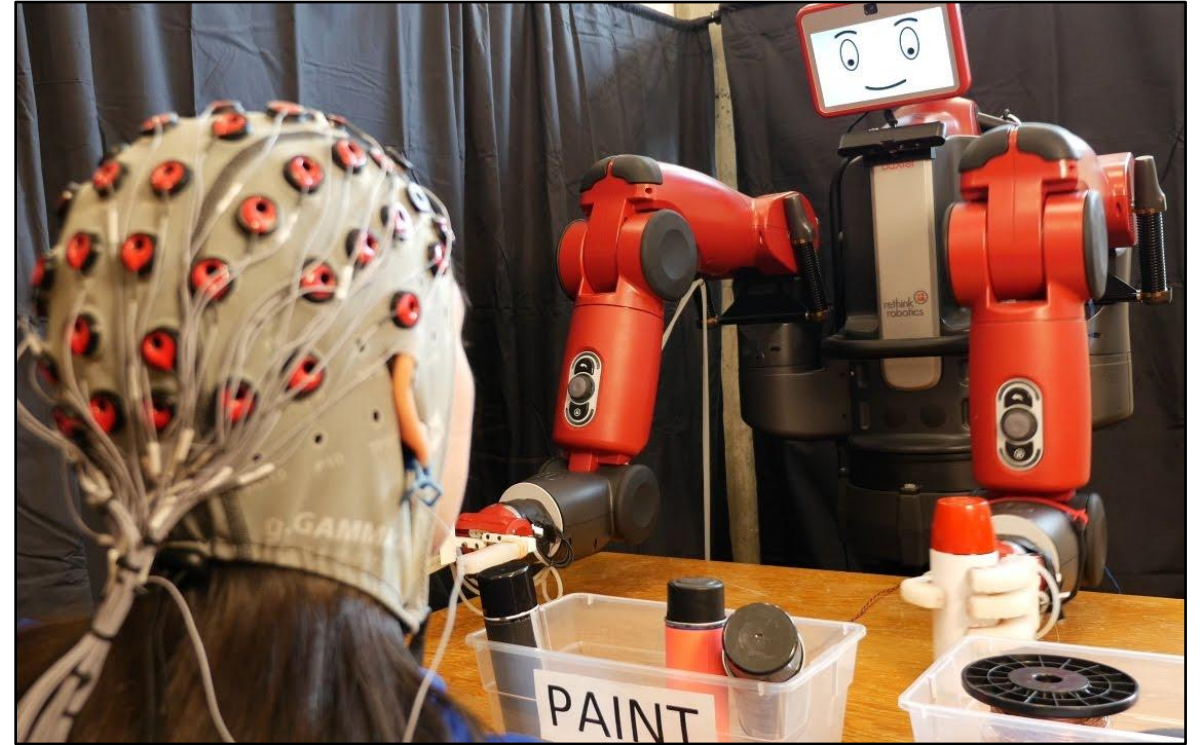
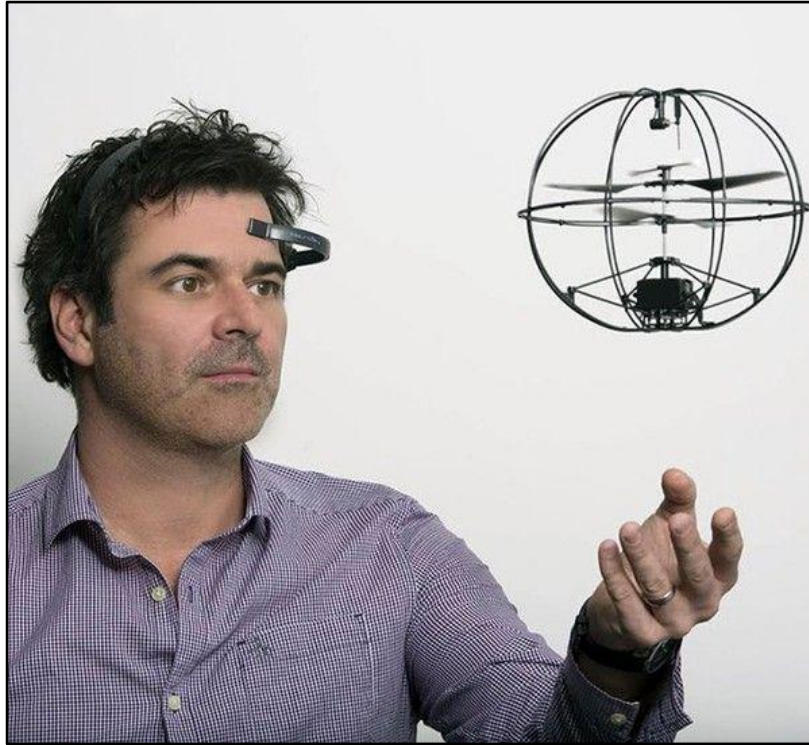
VBS3



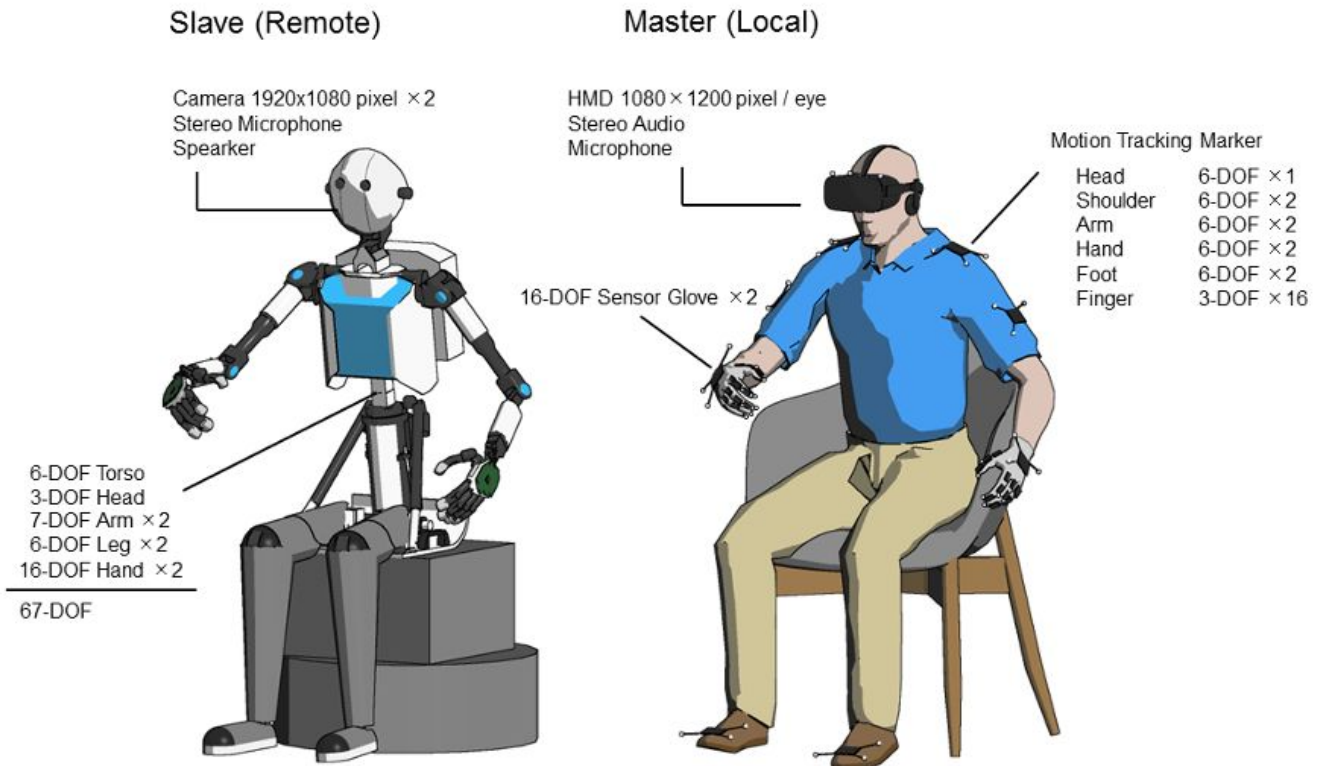
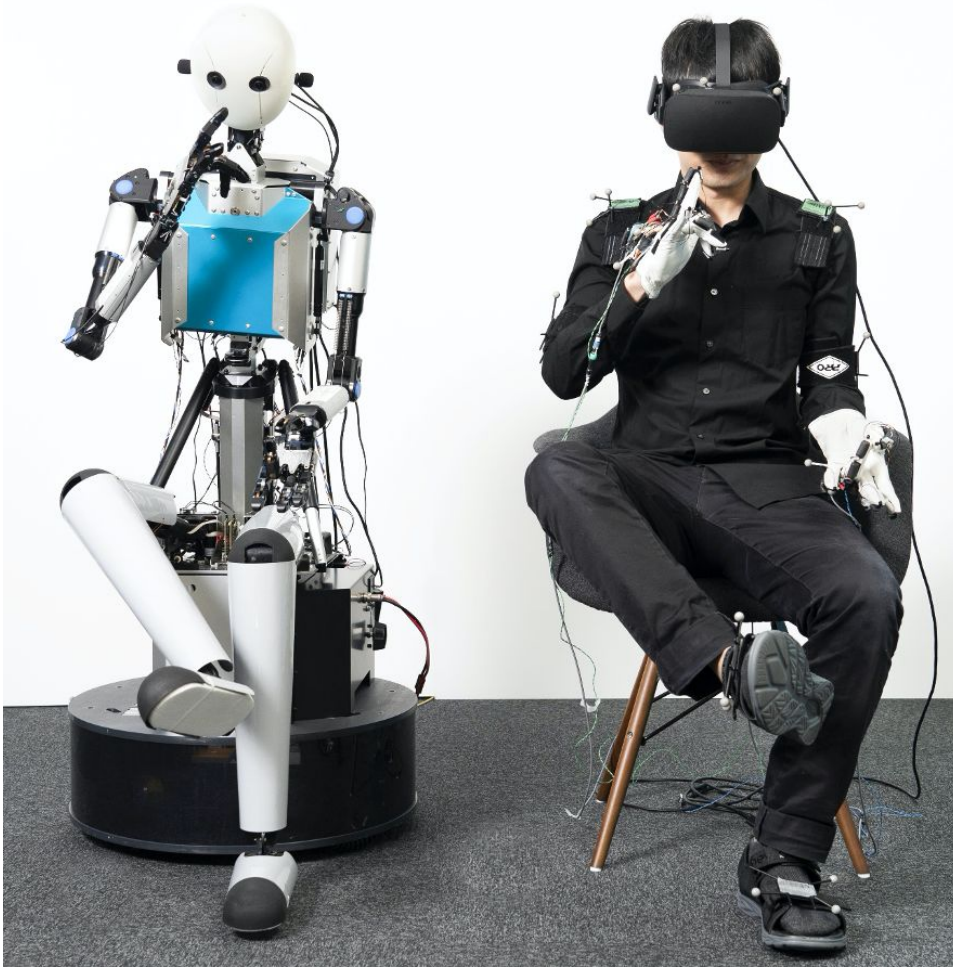
UGV



Brain Interface



Telexistence (Tachi Lab)



VR RHIB Simulator

RN working with Novatech, the University of Portsmouth, and Bohemia Interactive Simulations

- 3-DoF simulator chair
- Replica control console
- Gaming style steering wheel
- Oculus Rift headset
- VBS3 Software

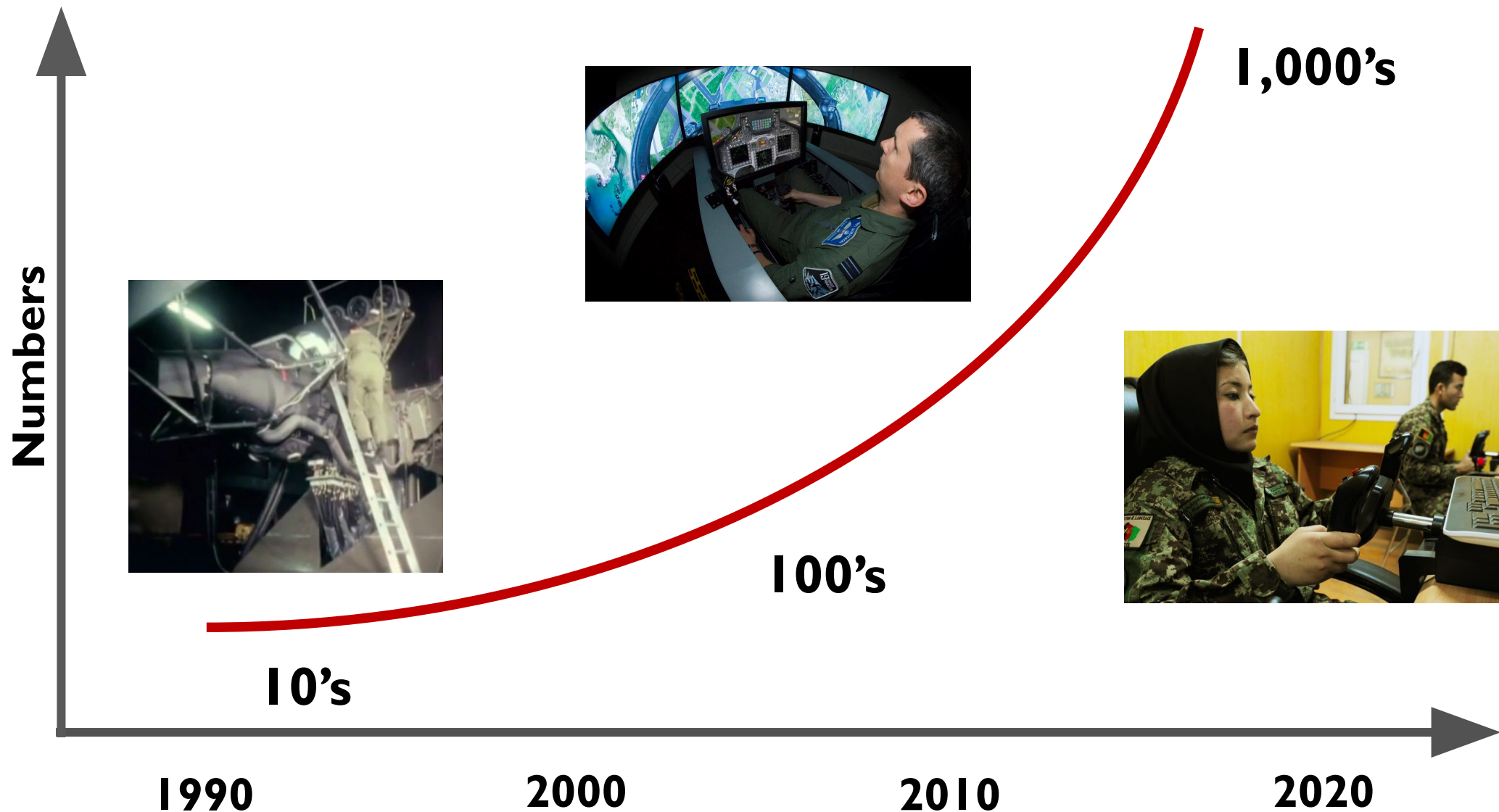


Simulation, Gaming and Remote/Autonomous Systems

Simulation Now - Land, Sea, Air, Anywhere



Military Access to Simulation



Simulation
(VBS3)

Experimentation

Autonomous
Systems





Machine Learning Agents



Unity Games Engine Machine Learning Agents *AI Training*



Machine Learning Agents

Simultaneous Training Demo

Imitation learning



Gaming Innovation

Apex Legends (Team-Based Battle Royale)

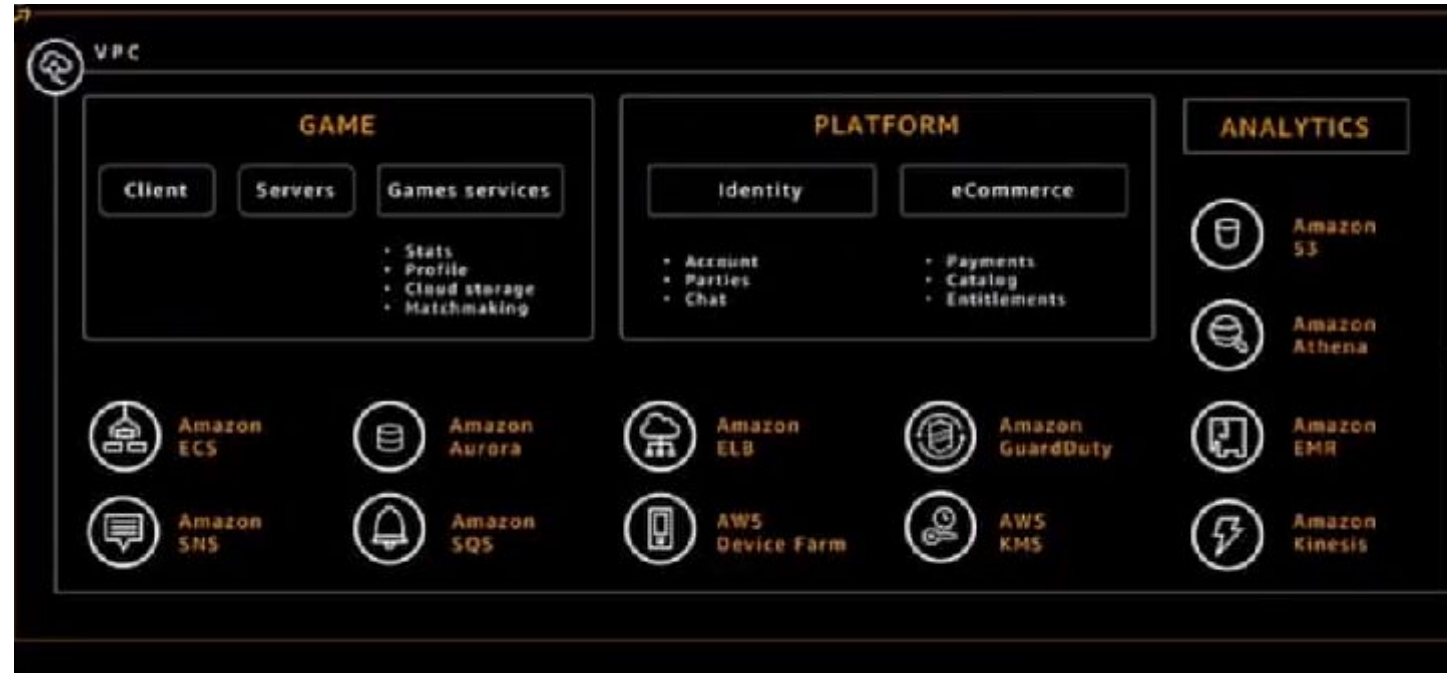
- Released 2019 - 50 Million Players Joined in One Month
- A novel ping system allows teammates to mark supplies, locations, and enemies



Fortnite Hosting



- Epic Games exploits Amazon Web Services (AWS)
- Fortnite servers around the world to reduce latency
- Each month Epic Games collects two petabytes of data
- Data can be used to make games more “compelling”



Stovepipes of Data



What about “Digital Twins”?



Final Thoughts

Ender's Game Film - 2013



Ender's Game



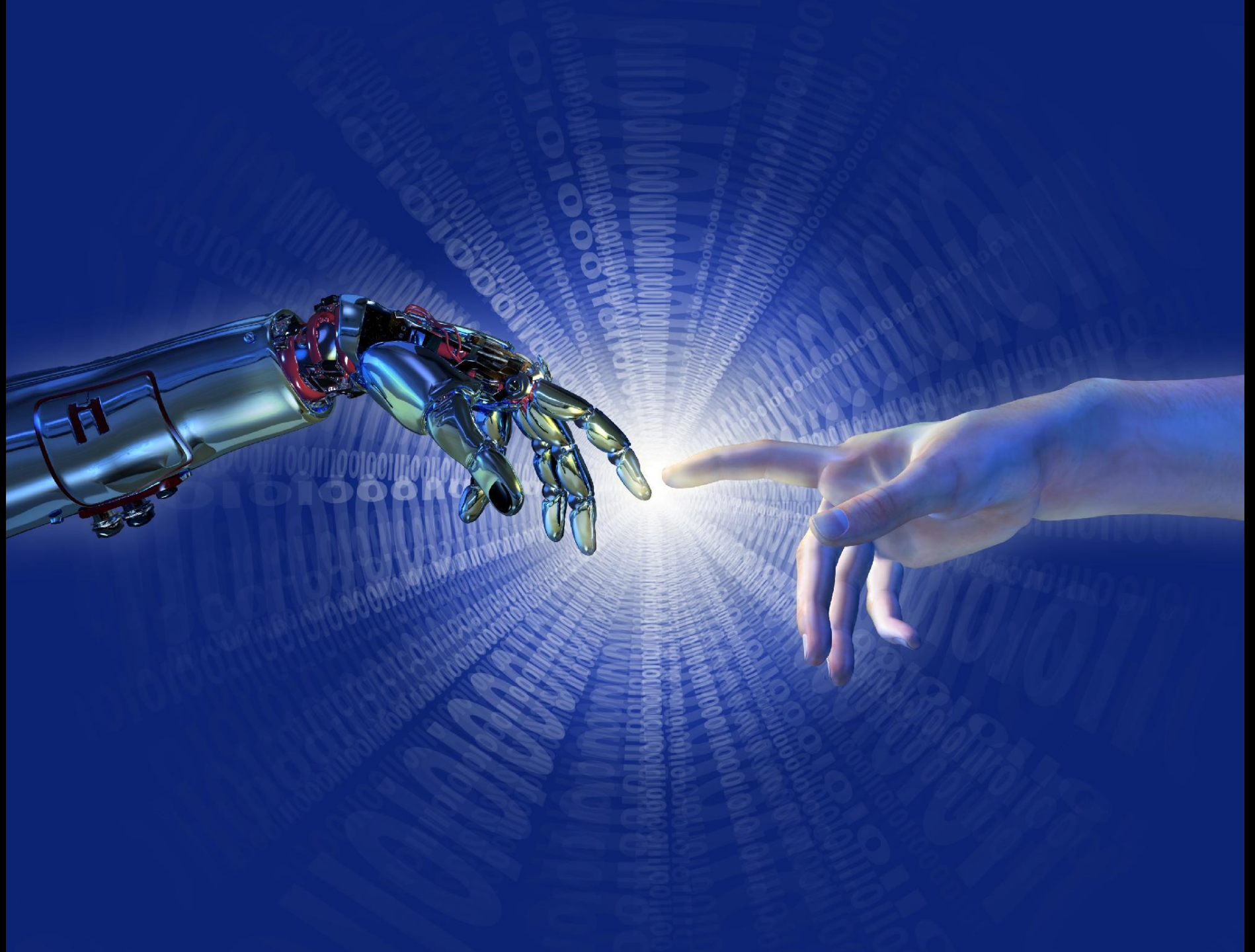
Leadership

Intuitive Interfaces



Remotely-Operated/Autonomous Agents

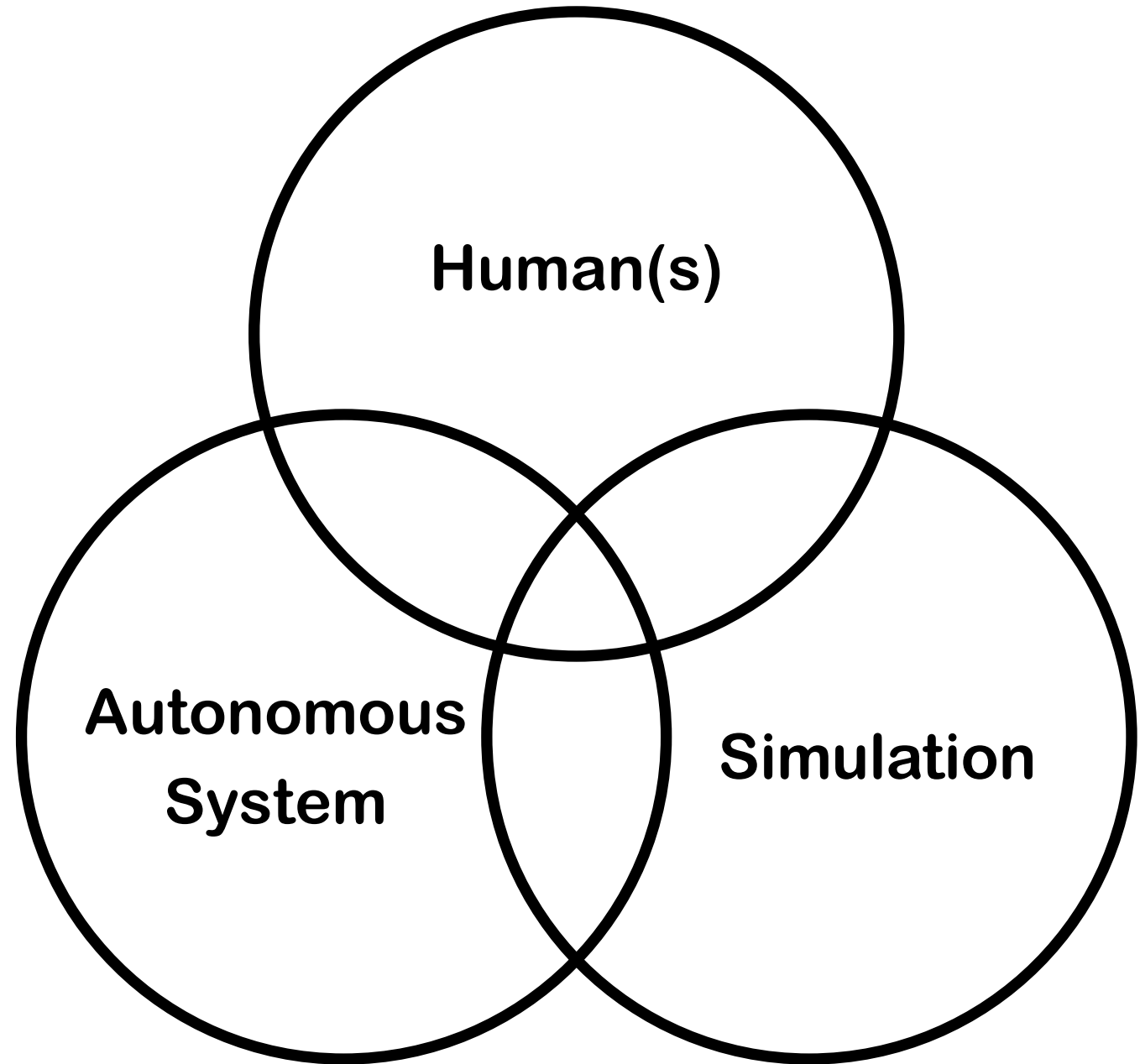
**Maximise
the
Strengths
of Both**



**Test & Train
Test & Train
Test & Train**

.....

Test & Train



Questions?



(the slides will be made available)

Boeing MQ-25 Stingray (Aerial Refueling Drone)



Autonomy and Communications

High Communications



Low Communications



Single Role

Multi Role

NATO code	OF-10	OF-9	OF-8	OF-7	OF-6	OF-5	OF-4	OF-3	OF-2	OF-1	OF(D)	
 United Kingdom												
	Admiral of the Fleet	Admiral	Vice admiral	Rear admiral	Commodore	Captain	Commander	Lieutenant commander	Lieutenant	Sub lieutenant	Midshipman	Officer Cadet

NATO Code	OR-9	OR-8	OR-7	OR-6	OR-5	OR-4	OR-3	OR-2	OR-1
 United Kingdom					No equivalent		No equivalent		No equivalent
	Warrant officer class 1	Warrant officer class 2 (phased out 2014)	Chief petty officer	Petty officer	-	Leading rate	-	Able rate	-
	WO1	WO2	CPO	PO	-	LR	-	AB	-