Unmanned Vehicles in zukünftigen militärischen Szenarien



Quelle: http://www.muchomacho.com.br/wordpress/wp-content/uploads/2014/07/Transformers-carros-muchomacho.jpg am 23.06.2017

DWT-Forum Unmanned Vehicles, Bad Godesberg, 04./05.07.2017

Vorbemerkung

„If this book [my presentation, ML] *seems completely reasonable and all my extrapolations convincing, I shall not have succeeded in looking very far ahead; for the one fact about the Future we can be certain is that it will be utterly fantastic.“*

Arthur C. Clarke, Profiles of the Future, London 1982

Vorbemerkung

Clarke‘s 2nd Law:

[…] the only way of discovering the limits of the possible is to venture a little way past them into the impossible.

Arthur C. Clarke, Profiles of the Future, London 1982, p. 36


HAL 9000

Autonomie und Intelligenz

Eine grundsätzliche Unterscheidung:

Starke Künstliche Intelligenz:
das technische System ist „wirklich intelligent“

(kreativ, planend, lernend, empathisch?, selbstbewusst?)[1)]

Schwache Künstliche Intelligenz:
das technische System, beschränkt auf spezielle Aufgaben, simuliert intelligentes Verhalten, ist aber selbst nicht intelligent.

[1)] vgl. http://www.informatik.uni-oldenburg.de/~iug08/ki/Grundlagen_Starke_KI_vs._Schwache_KI.html abgerufen am 30.05.2017

Autonomie und Intelligenz

Autonomie
(altgriechisch αὐτονομία *autonomía* ‚Eigengesetzlichkeit', ‚Selbstständigkeit', aus αὐτός *autós* ‚selbst' und νόμος *nómos* ‚Gesetz')

Quelle: https://de.wikipedia.org/wiki/Autonomie , abgerufen am 27.05.2017

Autonomie und Intelligenz

Technische Autonomie:

System ist autonom in Hinsicht α unter (normalerweise nicht ausgesprochenen) Randbedingungen b

Nutzer

Energie

Umwelt

Mobilität

Information

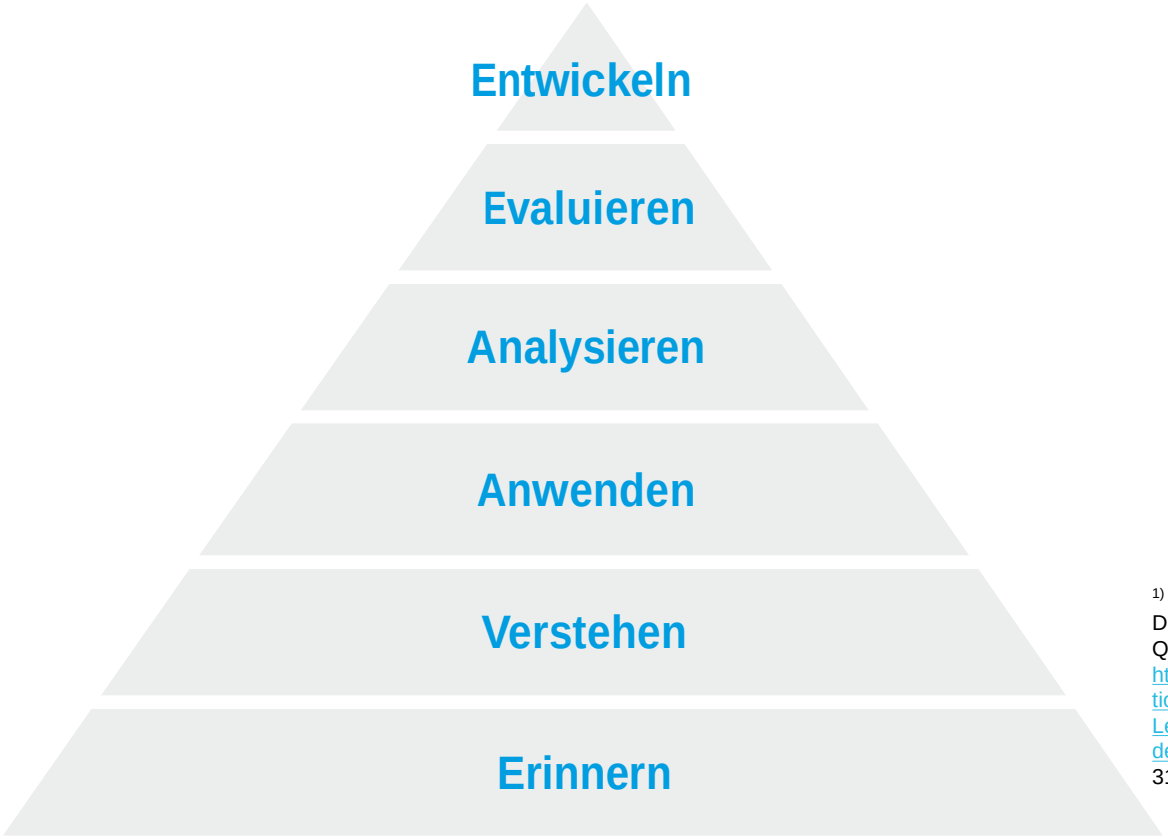
Quelle: Gottschalk-Mazous, N., „Autonomie“ und die Autonomie „autonomer technischer Systeme“, DGPhil2008, S.5.

Autonomie und Intelligenz

Alle aktuellen technisch autonomen Systeme sind schwache künstliche Intelligenzen!

Autonomie und Intelligenz

Die kognitiven Fähigkeiten des Menschen:[1)]



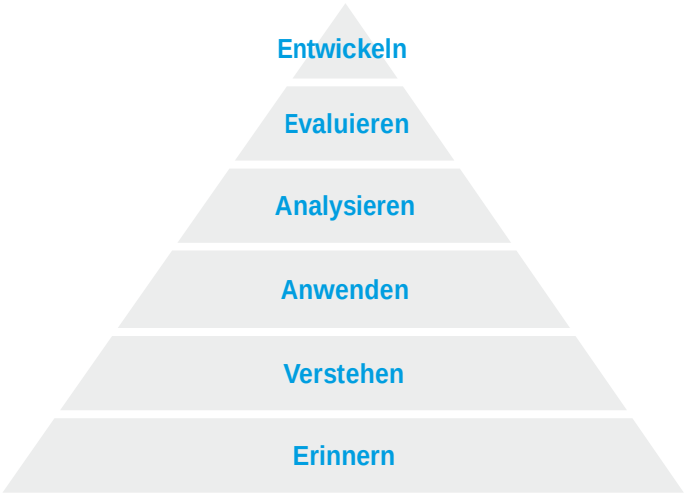
[1)] Nach Bloom, B. S. (1956). Cognitive Domain. Longman.
Quelle: https://www.bitkom.org/noindex/Publikationen/2017/Leitfaden/Bitkom-Leitfaden-KI-verstehen-als-Automation-des-Entscheidens-2-Mai-2017.pdf am 31.05.2017

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Autonomie und Intelligenz

Alternative Sichtweise:

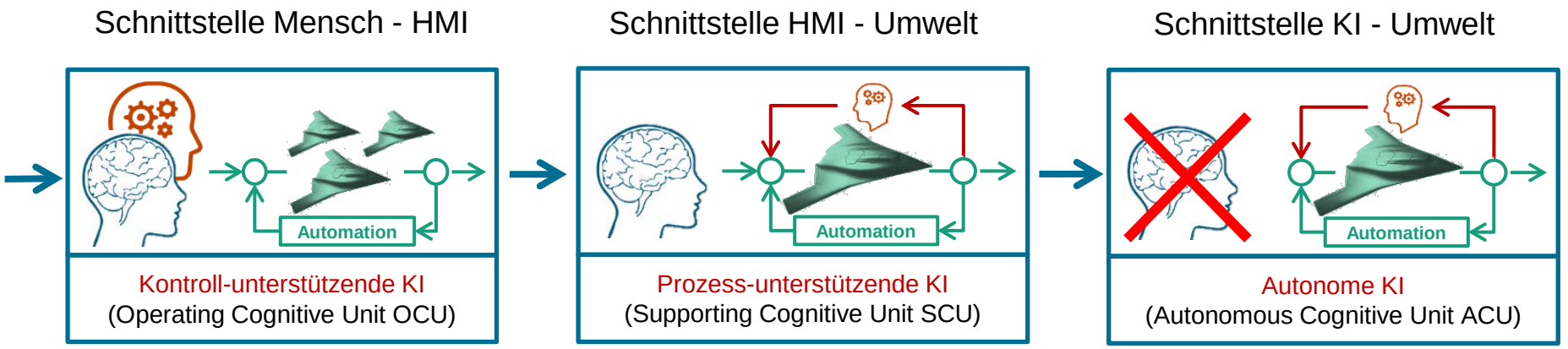
Es geht weniger um die bloße Simulation menschlicher Fähigkeiten, sondern um die Frage, auf welcher Stufe (und bis zu welchem Ausmaß) autonome Systeme Entscheidungen unterstützen können.



Quelle:
https://www.bitkom.org/noindex/Publikationen/2017/Leitfaden/Bitkom-Leitfaden-KI-verstehen-als-Automation-des-Entscheidens-2-Mai-2017.pdf am 31.05.2017

Autonomie und Intelligenz

Inhärenter Trend: Automation/Autonomisierung



Quelle: verändert nach Onken, Reiner; Schulte, Axel: Buch „System-Ergonomic Design of Cognitive Automation“, Kapitel „Dual-Mode Cognitive Design of Vehicle Guidance and ControlWork Systems“ (https://link.springer.com/book/10.1007%2F978-3-642-03135-9)

Autonomie und Intelligenz



Quelle: https://www.bitkom.org/noindex/Publikationen/2017/Leitfaden/Bitkom-Leitfaden-KI-verstehen-als-Automation-des-Entscheidens-2-Mai-2017.pdf am 31.05.2017

Einige Beispiele

(manchmal kommt es doch auf die Größe an …)

Einige Beispiele

Groß **(geht immer …)**

Zukunftskonzepte (Mutterschiffe)

Überwasserplattformen als Mutterschiffe

- Schiffe mit segmentiertem Flugdeck
  - Dreadnought T2050 (Studie Startpoint, 2015)

    Trimaran-Rumpf mit Flug- und Welldeck.
    V_{max} 90 km/h. Schleichfahrt halbgetaucht.
    Flugdeck seitlich erweiterbar, Parallel-Betrieb.







Bild:http://www.startpoint.co.uk/press

Zukunftskonzepte

Flugzeuge als Mutterschiffe

- Höhere Mobilität
  - DARPA Gremlins (2015)

    Ziel: billige Systeme für umkämpften Luftraum.

    TS ca. 20-mal einsetzbar.

    Start aus Luftfahrzeugen, Landung immer in einem C-130 Mutterschiff.

  - BAE Transformer (2014)

    Vision für das Jahr 2040.

    MS konstituiert sich aus heterogenen TS (modulare Robotik).





Bild: http://www.darpa.mil/news-events/2015-08-28, http://www.baesystems.com/en/feature/aircraft-technologies-of-the-future

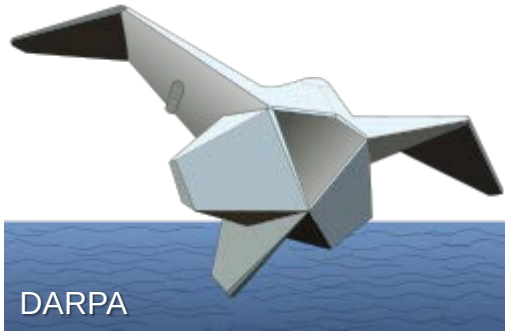
Zukunftskonzepte

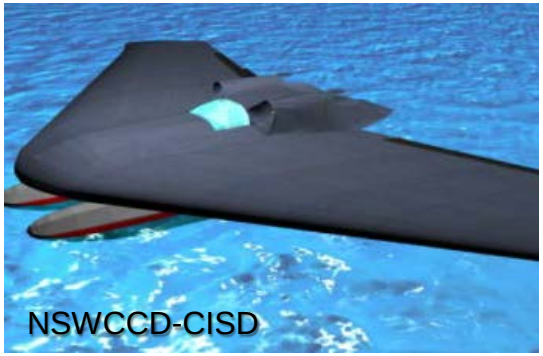
U-Boote als Mutterschiffe

- Tauchfähige Flugzeuge
  - DARPA Cormorant (Studie, bis 2006)

    Reichweite: 800 km,
    Zweck: Luftangriff
  - DARPA Submersible Aircraft (2008, nicht finanziert)

    Zielvorgabe (Hinweg):
    - Fliegen: 1.850 km
    - Schwimmen: 370 km
    - Tauchen: 44 km
    - Loiter: 3 Tage









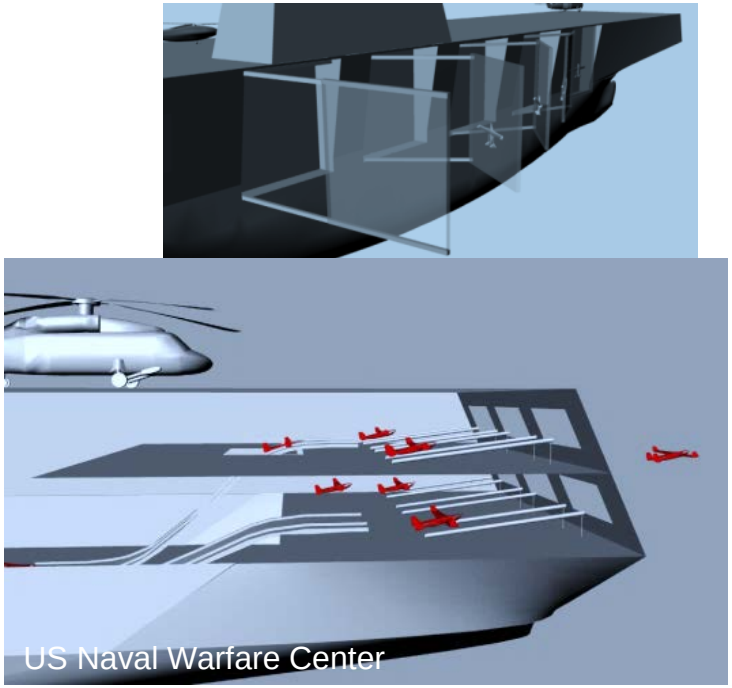
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Bild: https://en.wikipedia.org/wiki/Lockheed_Martin_Cormorant, www.nrl.navy.mil/content_images/Spectra_Winter_2014.pdf, www.dtic.mil/dtic/tr/fulltext/u2/a554344.pdf, http://iopscience.iop.org/article/10.1088/1748-3182/9/3/031001/meta;jsessionid=E2F9B0C7F065FDC8C57097FFBD2EE8C8.c1

Relevante Zukunftstechnologien

Massenstart von UxS-Tochterschiffen

- Militärische Studie (US Naval Surface Warfare Center 2009)



- Ziviles Kunstprojekt (AEC und Intel, 2015)



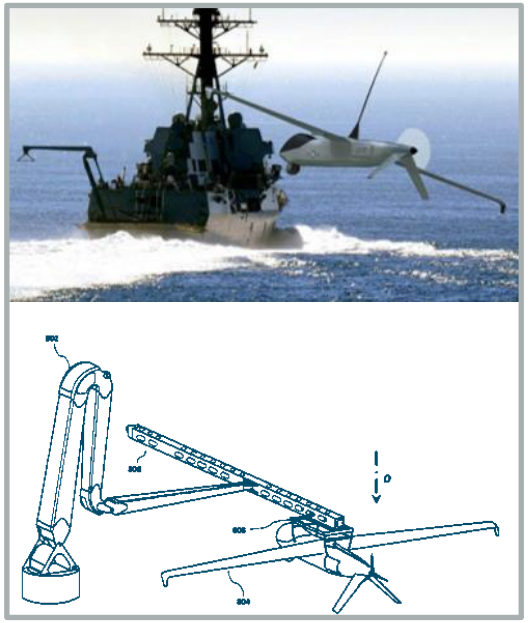
Bild: http://www.aec.at/feature/drone100/, www.dtic.mil/get-tr-doc/pdf?AD=ADA518429

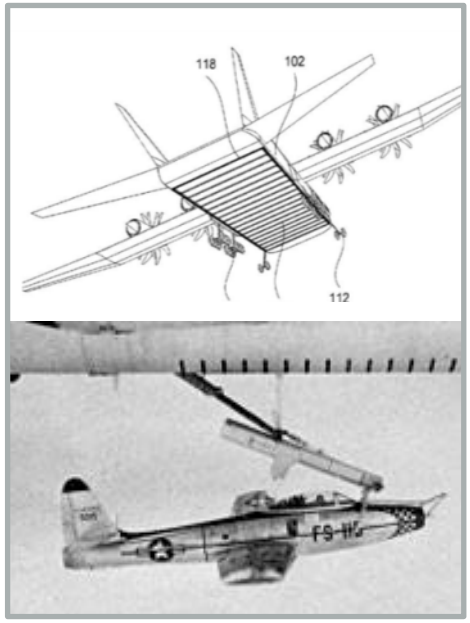
Relevante Zukunftstechnologien

Docking

- Verschiedene Dockingkonzepte
  - DARPA TERN (links)
  - US Projekt FICON + Boeing Frachtflugzeug (mitte)
  - EU FP7 Recreate + Apollo-Programm (rechts)
  - ETH Zürich Distributed Flight Array (oben)









Bildquellen: siehe Notizenseite

Relevante Zukunftstechnologien

Docking

- Punktgenaues Landen mit Aktorik zum Lageausgleich und autonomen Festklammern









Bildquellen: http://www.darpa.mil/news-events/2015-09-10, http://bdml.stanford.edu/uploads/Main/PerchingVideos/SequenceWallAndLaserCropSmall.jpg, http://www.gizmag.com/perching-mav-urbana-champaign/22408/

Relevante Zukunftstechnologien

Docking

- Autonomes, dynamisches Greifen als Grundlage für Landung und Festklammern

2014 IEEE International Conference on Robotics & Automation (ICRA)
Hong Kong Convention and Exhibition Center
May 31 - June 7, 2014. Hong Kong, China

Toward Image Based Visual Servoing for Aerial Grasping and Perching

Justin Thomas, Giuseppe Loianno, Koushil Sreenath, and Vijay Kumar



Bildquellen:http://www.cmu.edu/me/hdr/ICRA2014.html

Einige Beispiele

Klein (bis ganz klein …)

Idea of System — Autonomous Logistic Transport UAV

1. Summarising Description

A family of systems of different VTOL-capable unmanned aerial platforms and different modularised transport boxes.

On demand pick up and delivery of the transport modules is handled autonomous. For long-haul transport, bigger and more efficient platforms for packages of transport modules are used. Smaller robust tactical platforms serve for distribution into the theatre. There are different types of container modules (for logistic transport, medical cabins, energy supply units, mobile shelters, munitions, modularised close-in-weapon-systems).



Idea of System — Autonomous Battlefield MedEvac System

1. Summarising Description

Flying VTOL platform with shrouded fans that can land in any confined space only little wider than its own dimension. The platform comprises e.g. of an armoured medical compartment with space for up to two wounded soldiers and one attendant. The medical compartment is equipped with automated diagnostic and therapeutic tools and allows early enlistment of specialists via telemedicine equipment.

For use in intensive combat situations a humanoid robot can be deployed which recovers the injured soldier and loads him into the Medevac.



Entwickelt zusammen mit Isdefe für EDA OB Project "Technology Watch Follow-On (TWFO)" 15.ESI.OP.201

Idea of System — Fully autonomous military convoy

1. Summarising Description

A system of multiple unmanned ground vehicles for automated transport of military goods and equipment between two stations (military camps, buildings, …).
The system uses prescribed ways or plans its route independently, classifies the terrain it has to traverse and scans for potential threats. The leading UGV can be specially equipped to counter IED threats in out of area missions.
In case the convoy gets disconnected or communication is lost, the convoy or individual vehicles may autonomously decide whether to continue or to turn to a safe base (e.g. return to starting point).

Insert instructive picture(s) [ALT-e-g-d]

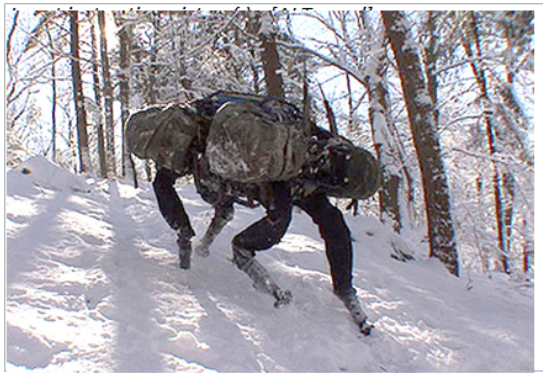


Idea of System — Autonomous Beast of Burden/Watch Dog

1. Summarising Description

Walking or driving machine which is able to follow a soldier wherever he walks without any need for remote operation. Serves to carry the military equipment of infantry soldiers or supply (food, energy, munition, …) in missions with durations of several days.

Apart from the transport task such a system could also be equipped with sensor payloads or even weapons. Using these it could be deployed as an infantry advance guard for special troops or to protect their camp at night.



Entwickelt zusammen mit Isdefe für EDA OB Project "Technology Watch Follow-On (TWFO)" 15.ESI.OP.201

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Idea of System

„Canal Worm“

1. Summarising Description

This is a small autonomous system that can crawl on/in earth, unnoticed from offenders. It has a snake like platform that uses peristaltic or serpentine locomotion. Alternatively it can have an insect-like flexible torso with inner or outer skeleton and a number of legs, comparable to e.g. centipedes.

Inside its body it is equipped with miniature cameras or microphones or additional sensors. It clandestinely approaches a camp or building and moves in tubes or among piles of debris to remain unseen. After it has gathered information or performed reconnaissance tasks some types return while others can decompose themselves.



Idea of System

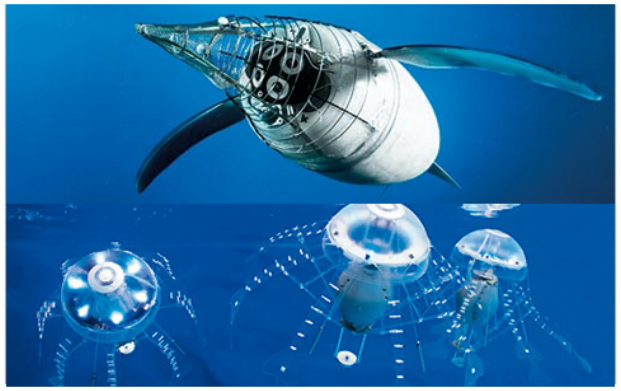
AUV Swarm for Underwater Situational Awareness

1. Summarising Description

Multiple AUV that cooperatively explore denied or hazardous underwater areas, e.g. coastal waters. They operate from larger motherships that release the swarm at a sufficient stand off distance outside detection range of potential adversaries.

Depending on flow speed and mission type the AUV range from nearly undetectable biomimetic robotic animals (fish, penguin, jelly fish, ..) to larger propeller driven vessels with endurances from hours to weeks, and operating ranges reaching from hundreds of meters to over one hundred kilometres.

Communication and coordination within the swarm will be based on light or on weak acoustic signals and use chain- or network-like message transport.



Entwickelt zusammen mit Isdefe für EDA OB Project “Technology Watch Follow-On (TWFO)” 15.ESI.OP.201

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Idea of System

Autonomous Maintenance System

1. Summarising Description

System that independently checks out other systems or materials that reach or return to a base with respect to structural and functional integrity, e.g. visual or ultrasound inspection of structural damages, evaluating status information of health monitoring systems, testing of electronic subsystems condition or checking of operating supplies.

Sends its diagnosis to a central maintenance system that triggers necessary maintenance tasks in an 24/7 operation mode. Simple maintenance tasks will be executed self-dependent by the autonomous platforms, for other tasks they assist the maintenance personnel.

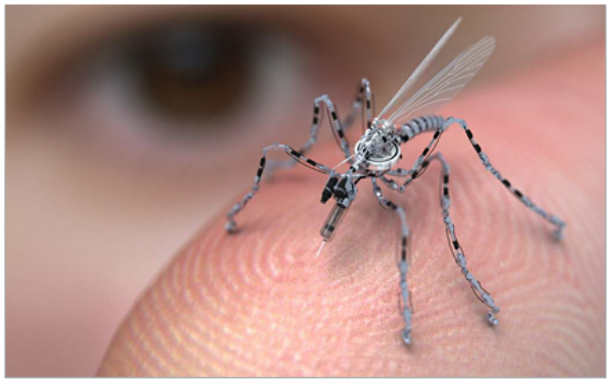


Idea of System

„Port-Pirate“

1. Summarising Description

- A small and inconspicuous robotic insect of about 100 mg weight, or other miniature mobile platform that serves to achieve access to any computer interface and steal information. The Port-Pirate is released in the vicinity of adversarial camps or buildings and actively searches for wireless computer signals, telephone landlines or else that can serve as a hint to electronic control and communication devices.
- When it has approached a target it tries to physically access the IT system and execute sophisticated algorithms to overcome security barriers. It transfers its data by Wi-Fi or returns with it to its base.



Entwickelt zusammen mit Isdefe für EDA OB Project “Technology Watch Follow-On (TWFO)” 15.ESI.OP.201

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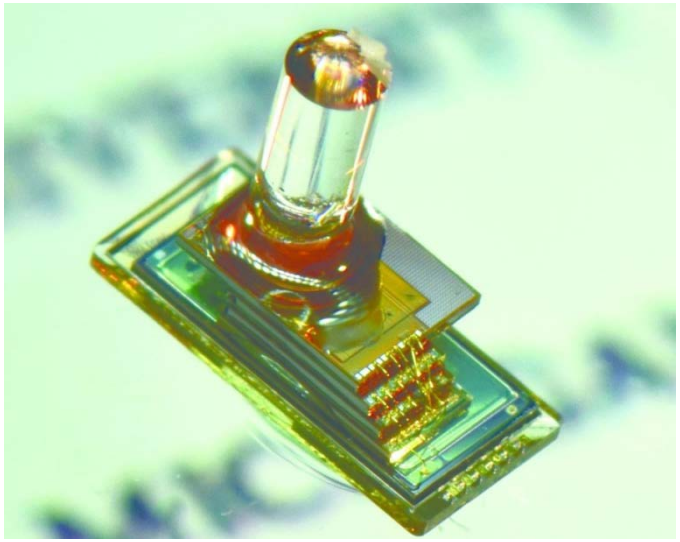
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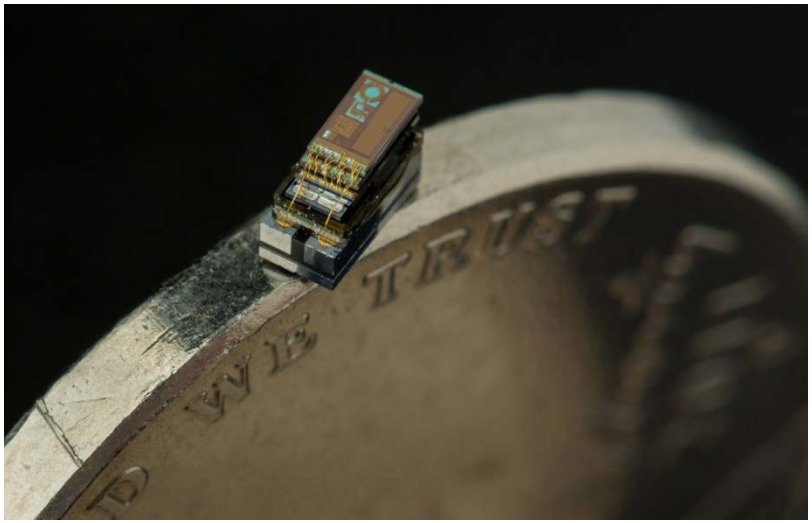
Einige Beispiele

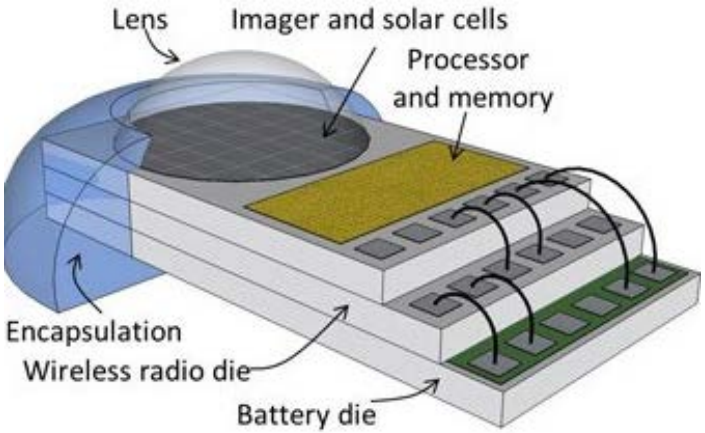
Winzig **(fast unsichtbar …)**

Smart Dust

Vollständiger Computer in 1 mm³







Quelle: https://scr.wfcdn.de/12413/Smart-Dust-Computer-1429181312-0-1.jpg am 30.06.2017

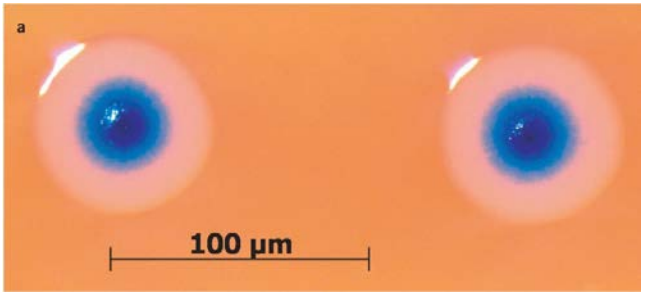
Einige Beispiele



Quelle: http://thenewcomposersblog.files.wordpress.com/2011/11/lupe.jpg am 30.06.2017

Synthethische Biologie

Künstliche Zellen



Mycoplasma-mycoides-Kultur: Der blaue Bakterienhaufen besteht aus Hunderten von einzelnen Zellen, deren Genom im Reagenzglas aus den DNA-Bausteinen geschaffen wurde.

Quelle: http://cdn4.spiegel.de/images/image-90163-galleryV9-pfho-90163.jpg am 30.06.2017



DNA: 473 Gene reichen aus

Quelle: http://cdn1.spiegel.de/images/image-973768-860_galleryfree-gjjq-973768.jpg am 30.06.2017



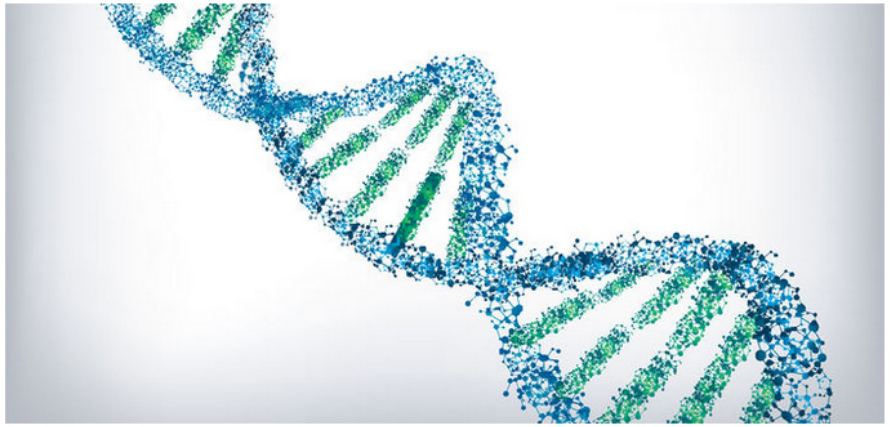
Quelle: http://www.wissen.de/sites/default/files/wissensserver/styles/small/wissensserver/jadis/incoming/1522122.jpg am 30.06.2017

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Synthethische Biologie

Künstliche Zellen



A new method of storing data in the nucleotide bases of DNA is the highest-density storage scheme ever invented. Novi Elisa/shutterstock

DNA could store all of the world's data in one room

By Robert Service | Mar. 2, 2017 , 2:00 PM

Humanity has a data storage problem: More data were created in the past 2 years than in all of preceding history. And that torrent of information may soon outstrip the ability of hard drives to capture it. Now, researchers report that they've come up with a new way to encode digital data in DNA to create the highest-density large-scale data storage scheme ever invented. Capable of storing 215 petabytes (215 million gigabytes) in a single gram of DNA, the system could, in principle, store every bit of datum ever recorded by humans in a container about the size and weight of a couple of pickup trucks. But whether the technology takes off may depend on its cost.

- **DNA digital data storage**
  (Nutzung von DNA
  als Datenspeicher)
  - extrem beständige und kompakte Datenspeicher

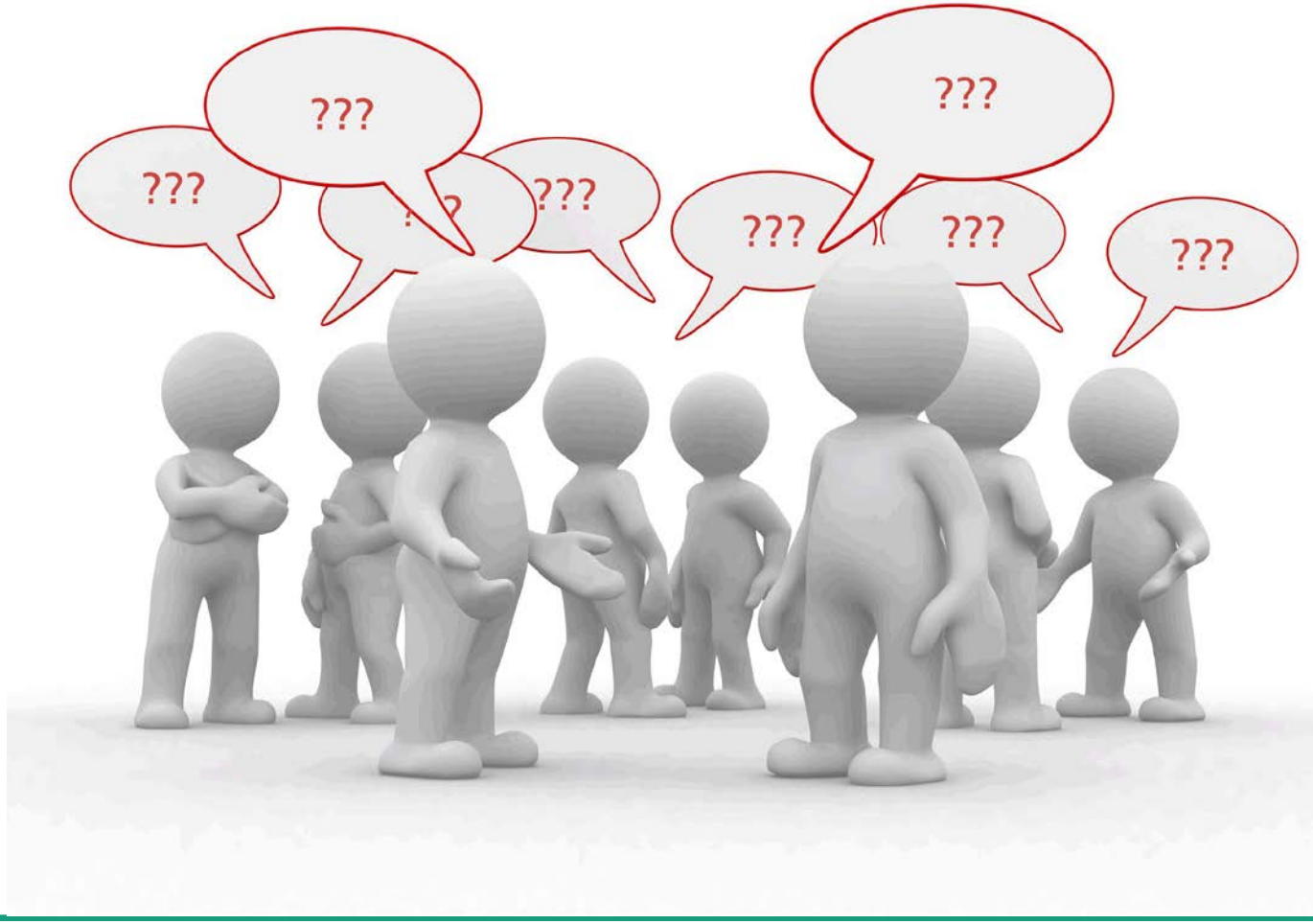
http://www.sciencemag.org

Der Versuch einer Zusammenfassung

- Unbemannte Systeme weisen zahlreiche Vorteile bei militärischen Anwendungen auf.
- Es ist davon auszugehen, dass sie zukünftig vermehrt und in unterschiedlichsten Variationen auf dem Gefechtsfeld auftreten werden.
- Unbemannte Systeme, insbesondere, wenn sie in größeren Mengen eingesetzt werden, müssen zwangsläufig (teil-)autonome Fähigkeiten besitzen.
- Durch die eingebaute technische Autonomie wohnt den unbemannten Systemen gleichzeitig ein hohes Potential für einen Rüstungswettlauf inne.
- Wesentliches Kriterium wird dabei auch die Möglichkeit zur Miniaturisierung sein.

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Vielen Dank für die Aufmerksamkeit!



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