Germany’s Platform for Artificial Intelligence

Digitilization and Green Hydrogen in Metals Industry

October 2019
Germany’s Platform for Artificial Intelligence

Project duration: 2017-2022

Goal: Shaping AI for the needs of society and utilise its economic potential

- An innovation policy project launched by the Federal Ministry of Education and Research at the suggestion of acatech
- Expertise: working groups with 200 experts from science, economics and society
- Contents: technology-, economic- and society-related issues
- Results: user-scenarios, recommendations, guidelines and roadmaps
- Coordination: a managing office operated by acatech

Chairs

Anja Karliczek (Federal Minister of Education and Research)
Karl-Heinz Streibich (President of acatech)
What is a Self-Learning System?

Self-learning systems are machines, robots and software-applications which are able to manage abstract tasks autonomously without the necessity of coding each step. The learning process is data-driven.

- Ability to manage complex tasks
- Ability to adjust themselves to new situations and users
- Are stable in the face of unpredictable events
- Are based on Artificial Intelligence methods
Significance for Politics and Society

Self-learning systems are the next step in the digital transformation. They are fundamentally changing our living and working environment.

- Operational in public and private areas (e.g. autonomous mobility, household, emergency measures, …)
- Individual and social benefits – combatting future challenges (e.g. sustainability, demographic change)
- Enormous economic potential
- Fundamentally new human-robot relations
Topics of the Platform

7 interdisciplinary working groups from across different industries analyse the developments and the usability in the field of self-learning systems.

**Fields of Application**
- Mobility and Intelligent Transport Systems
- Health Care, Medical Technology, Care
- Hostile-to-life Environments

**Cross-Cutting Issues**
- Technological Enablers and Data Science
- **Future of Work and Human-Machine Interaction**
- IT Security, Privacy, Legal and Ethical Framework
- Business Model Innovation
WG2 – Future of Work and Human-Machine Interaction

Topics and fields of action:

- Fair, humane work in context of self-learning systems
- New competence requirements and qualification approaches
- Liveable Future: Benefit of self-learning systems for humans
- Hand in Hand: Man learns from machine learns from man
- Transparency, controllability and maintainability of self-learning systems
- Design principles for interaction with self-learning systems
- Role allocation between man and self-learning systems
- AI for productivity and innovation
- Management for digital transformation

Head of Working Group:
Elisabeth André, Universität Augsburg
Wilhelm Bauer, Fraunhofer IAO/Universität Stuttgart
Outs

- **Map on AI in Germany**
  - 600 examples of successful AI applications
  - Overview of almost 100 AI research institutions
  - New examples are added continuously

- The Working Groups have published a number of **papers** on different AI aspects (ongoing). English translations will be published soon
Application scenarios

Mobility

Against cancer

Rescue operations

Autonomous under water

Robotics

At the office
Further Information

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Shaping the next industrial revolution with you.

Digitalization and Green Hydrogen in Metals Industry
Global market leader in metallurgical plant construction

150 years of experience

Represented at over 50 locations worldwide with around 14,000 employees

Order intake in 2018

- America: 18%
- Europe, CIS: 36%
- EU/Western Europe: 36%
- Asia: 26%
- Africa: 5%

Order intake in 2018: €3.1 bn

Successful specialists
Valuable brands

Comprehensive range of solutions

Covering the entire process chain

Working for the largest and most innovative customers

Digital Products and Services

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Create added value

**Models**

**Theory-based**
- Need little data
- Understanding of underlying mechanisms required
- Powerful but hard to scale

**Experience-based**
- Easy to understand / develop
- Include knowledge and experience of experts
- Limited view if necessary

**data-driven**
- Easy to maintain and scale
- Consider all historical values
- Often too little data

Design calculations, process models, physical properties

$n_{ch} = \frac{[(1+f)u_0^2 - Y_0^2] + BRP(u_{19}^2 - Y_0^2)}{2f Q_f}$

Rules and structured experience knowledge

**Machine Learning, Pattern recognition / Classification**
Big River Steel - First Learning [Steel] Plant

1 Multi-Sensor System
   - Thickness, Width, Temperature, Flatness ...

2 Data
   - Signals
     - 15,000
   - Sensors
     - 2,700
   - 4 Terabyte per Month

3 Data Analysis
   - Pattern Recognition

4 Neural Network
   - Self-Learning System

CSP® plant
Osceola, USA, 12/2016
460 Employees
1.6 Mio. tons per Year
10,000 orders per Year
> 50,000 sensors
Product Digital Twin End-to-End

Product ID

"H-4711-0815"

Decision

"Ship"

Production Date

Surface Defects

Temperature

Thickness

Order

Customer: "Ford"

Width: 1255 mm ± 5

Thick.: 6 mm ± 0,5

Data from Previous Lines

Images

Dimension

"1259mm
6mm"
Genealogy has besides the relations, also to reflect all changes to the material: lengthening, trimming, cutting, slitting, welding, orientation changes,...
SMS Data Factory

provides data from any data sources in appropriate form and is the fundamental layer for data driven apps.
Green Hydrogen

Paul Wurth (SMS group) is New Lead Investor and Technology Partner of

- Joint focus on green hydrogen by industrialisation of electrolysis and Power-to-Liquid technology for large scale commercial projects.
- Plant builder Paul Wurth (SMS group) provides access to global metals industry, which increasingly uses renewable hydrogen.
Norsk E-Fuel Background

- Norsk e-Fuel is an EU Consortium of technology companies, green funds and a system integrator, promoting novel Power-to-Liquid (PtL) technologies in Norway.

- **Norks e-Fuel will develop and implement PtL projects** using renewable electricity to produce synthetic diesel, jet-fuel and chemicals from water and CO\(_2\) (100 % renewable).

- Building on **exclusive access to key technology and a world-wide patent**, Norsk e-Fuel offers the most efficient and economic PtL pathway.

- Located at the Herøya industrial park, the first plant Norsk e-Fuel *alpha* is targeting 8,000 t/a of production capacity.
Technology comparison

**Sunfire-HyLink / SynLink**

- Oxygen membrane (Solid Oxide Cell)
- Efficiency: 82 % or 3.7 kWh_{AC}/Nm^3_{LHV}
- High temperature (850 °C)
- Ability to electrolyse CO_2, most promising economics

**PEM electrolysis**

- Hydrogen membrane
- Efficiency: 50 – 60 % or 5 - 6 kWh_{AC}/Nm^3_{LHV}
- Low temperature (< 100 °C)
- Flexible operation from part load to full load (0 % - 300 %)

**Alkaline electrolysis**

- Hydroxide membrane
- Efficiency: 50 – 60 % or 5 - 6 kWh_{AC}/Nm^3_{LHV}
- Low temperature (< 100 °C)
Power-to-X production pathways

Additional efficiency through digitilization!
Well to Tank to wheel Investment need

**Direct charging**
- battery electric vehicle

**Hydrogen**
- fuel cell vehicle
  - H2-Plant
  - Storage
  - Transport

**Electrofuel**
- conventional vehicle
  - PtL Plant
  - Refining
  - Transport

*existing infrastructure*
*new investment*
Norsk E-Fuel ALPHA Project Maturity

- **Strong project consortium** with leading partners in respective areas and well-balanced geographical distribution

- **Equity financing available** from project partners
  Strong financial support in Norway and EU

- Responsibility for plant start-up lies with Paul Wurth (SMS group), company in the ironmaking area

- **Project location identified** and available for realization

- **Strong business model** with secured media supply (electricity and CO₂) and offtake (e-jet fuel and e-Chemicals)

- due to secured off-take, input and performance warranty from Paul Wurth (SMS group)
Based on electrolysis green electricity is used to convert water and CO$_2$ into renewable gases and fuels. These substitutes for mineral oil and natural gas, known as e-Gas, e-Fuel or e-Chemicals, replace fossil fuels in existing infrastructures.

FROM NORWAY FOR EUROPE