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Wenn Systeme selbstständig lernen...



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When systems learn independently...

Historical expert roundtable from November 2020. All four contributors' statements and forecasts are translated in full, in their original context. These are not present-day claims about AI capabilities. Original publisher artwork, logos and advertisements are retained in their original language.

Benefits, requirements, effort and costs for AI and ML

When systems learn independently...

For its current trend survey, ROBOTIK UND PRODUKTION asked experts about artificial intelligence and machine learning: potential and existing applications, benefits, added value, requirements, effort and costs. The contributors were Thomas Lantermann, Senior Consultant Digitalization at Mitsubishi Electric Industrial Automation; Dr. Martin Bleider, Head of Consulting Services at Hahn Digital; Alexander Trebing, Managing Director at Cretec; and Michal Maly, Co-founder and Director of AI at Photoneo.

Which robotics applications and functions offer the greatest potential for AI and machine learning? Where can they already be used today?

Thomas Lantermann, Mitsubishi Electric:

Time is money. This applies to installing, programming and using robots in production, especially given the lack of specialists. AI can support all these areas. Robot positioning in a system could, for example, be simulated and adjusted automatically in advance. Camera systems can handle safe manipulation themselves. Programming can optimise travel paths for speed and energy efficiency. AI automatically avoids collisions when several robots are used. During production, it supports continuous self-optimisation and shorter application cycles. Predictive maintenance directly in the robot prevents expensive downtime and increases cost-effectiveness.

Dr. Martin Bleider, Hahn Digital: The

Thomas Lantermann, Mitsubishi Electric

"AI is an investment, but payback should come within a few months. In the long run, no company can avoid it."



Bild: Mitsubishi Electric Europe B.V.

technology is most effective wherever patterns and systematic relationships can be recognised. Applications range from anomaly detection for maintenance and predictive maintenance to shorter commissioning through optimal process

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settings, and AI-based robot path optimisation including collision avoidance. AI-based closed-loop control can also increase OEE in already fully automated production processes. All these applications except the last are already used in many fields; closed AI control loops remain the exception.

Alexander Trebing, Cretec

“AI and machine learning are currently at the state of scientific research, not established engineering practice.”



Bild: Cretec GmbH

Alexander Trebing, Cretec: When an industrial robot is purchased today, programming should be as simple as possible so that it can repeatedly perform new tasks. The next step must be a new software phase for industrial robots. What could be simpler than graphical parameterisation instead of programming? The robot is manually guided and trained by setting gripping poses, just as we would show an employee. Once the workflow has been performed correctly and the robot understands its surroundings, it can test and improve the movement sequence independently. AI can teach the robot its work; machine learning lets it improve that work itself.

Michal Maly, Photoneo: We can already see

automation benefiting from advances in convolutional neural networks. We can find and classify objects of different shapes that do not share a single geometric description but belong to a general class defined through

Michal Maly, Photoneo

“Reinforcement learning is promising for complex robot movements.”



Maly, Photoneo:

The process naturally requires finer tuning, sufficient variations and attention to extreme cases. Pilot testing is also necessary. Gathering data can sometimes

examples. The same applies to quality inspection.

What benefits can users expect from AI and machine learning? Where is the greatest added value?

Trebing, Cretec: The main benefit is that virtually any robot can be used. We will no longer need programmers who are in very short supply. Instead, thoughtful employees can much more easily move into automation, defining new tasks and teaching them to robots without extensive prior knowledge.

Dr. Bleider, Hahn Digital: The greatest added

value is automatically gaining insight into the causes of process changes or errors and automatically improving these anomalies. AI strongly supports and partially automates the work of process engineers who spend considerable manual effort stabilising processes and improving performance indicators. However, success will still depend on the interplay of AI, data and expertise: AI cannot replace a process expert.

Maly, Photoneo: Many objects cannot be described by a precise geometric definition of shape or quality. An apple, for example, is not a sphere: each apple has a different shape and size. Likewise, we can recognise a burnt cake but cannot write a definition for it. AI helps here. You provide dozens of examples, and AI learns from them.

Lantermann, Mitsubishi Electric: The greatest benefit is lower programming costs. AI and ML enable system design, testing and adjustments in advance. Technologies such as augmented reality let designers experience a system live during development and immediately improve it. ML continuously checks product quality and can issue early warnings. Parts recognised as defective during production can be removed immediately, avoiding expensive rework. Various analytical techniques combined with AI improve production stability and robustness.

What requirements must companies meet to use AI and machine learning? How much effort and cost are involved in getting started?

be difficult: if one defective or poor-quality item occurs per 1,000 items and you want 100 examples, these must come from 100,000 produced items. Previously collected quality-management samples can be reused if they were retained. Improving and refining the process takes time, just as in conventional quality control.

Lantermann, Mitsubishi Electric: The goal is to improve systems and secure production quality over the long term. Direct implementation in devices or support through cloud applications are possible, as is processing big data at the edge. AI can perform big-data analytics directly in

production in advance. AI is an investment, but payback should be very quick - in our experience often within a few months. In the long run, no company can avoid it.

Dr. Bleider, Hahn Digital: Companies should assess the technology's potential realistically and use this to select suitable applications carefully. Defining the problem and implementing the solution require either intensive in-house learning or the right partner. Costs cannot be stated generally: they vary greatly and depend on the application.

Dr. Martin Bleider, Hahn Digital

"It is essential to develop meta-technologies that make the black-box approaches of AI models more transparent."



Trebing, Cretec: Completing a project based on AI today unfortunately still involves considerable effort and cost. AI and ML are

currently at the state of scientific research rather than established engineering practice. Applications exist, can be solved and have in some cases already been implemented. For now, experts must support implementation and develop tomorrow's products from it. Once this has become standard practice, effort will be low. Getting started is already possible without great effort or cost. The process can proceed step by step and can begin now.

Looking three years ahead, how far will AI and machine learning have advanced in practical robotics?

Dr. Bleider, Hahn Digital: If it is unclear why AI reaches a particular result, there will be no trust in it for absolutely critical aspects. This is particularly problematic in multilayer neural networks. It is essential to develop and supply meta-technologies that make the black-box approaches of AI models more transparent and allow knowledgeable experts to validate them.

Maly, Photoneo: Reinforcement learning seems promising for suggesting complex movements so that a robot can adjust an object's position before grasping it. I also expect robots to develop a better practical understanding of the world. Other AI fields are advancing too, such as natural-language processing, which can simplify instructions for immediate tasks with straightforward execution.

Trebing, Cretec: Digitalisation is accelerating in every field, providing greater computing power for AI and machine deep learning alongside a growing range of easily integrated AI algorithms. In the past three years, industrial robots and collaborative systems using machine deep learning have opened many new applications and strongly influenced numerous industrial sectors. In three years, with coronavirus accelerating digitalisation and continued rapid digital innovation, flexible applications will emerge that are not yet being considered for technological and economic reasons.

Lantermann, Mitsubishi Electric: At the current pace of AI innovation, three years is a long time. More datasets from different production and everyday situations are becoming available. AI models will consequently have a broader basis and support us in more areas of daily life. Security must not be underestimated: AI will also help protect our data, processes and robots against cyberattacks. **(fiz)**

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