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Advances in Piezoelectric Actuator Technologies for Defense Systems

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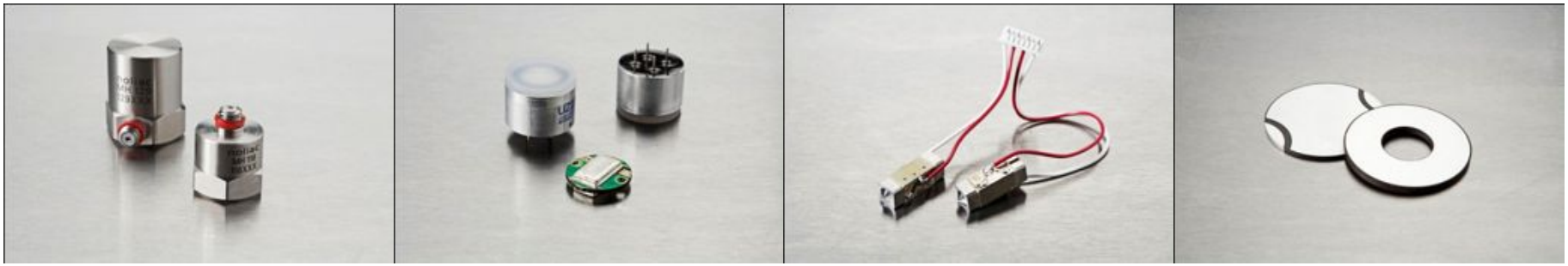
Contents

- Background
  - Noliac Group
  - Piezoelectric technology
- Amplified actuator
  - Ex: active vibration control
- Piezoelectric Actuator Drive (PAD)
  - Ex: beam steering
- Conclusions

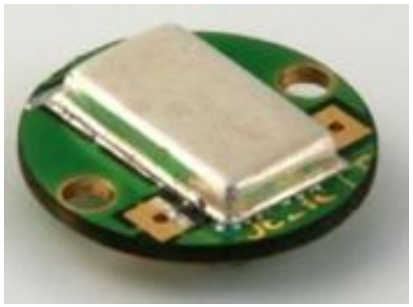
Noliac Group

- HQ in Denmark, 2 divisions in Czech Republic, R&D facility in Munich
- 100 employees
- Piezoelectric technology and products
  - Actuators, micro positioning, vibration control…
  - Sensors, vibration, shock, microphones…
  - Generators, energy harvesters, impact…
  - Transducers, flow, distance, sonar…
  - Piezoelectric Actuator Drives, aerospace, medical, robotics…



Product Overview





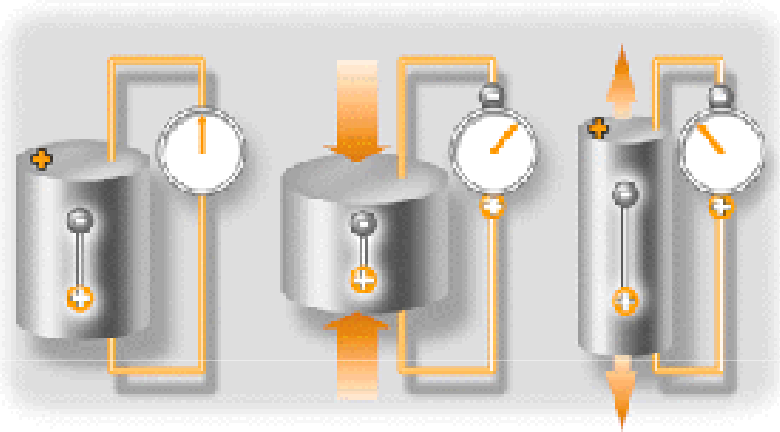




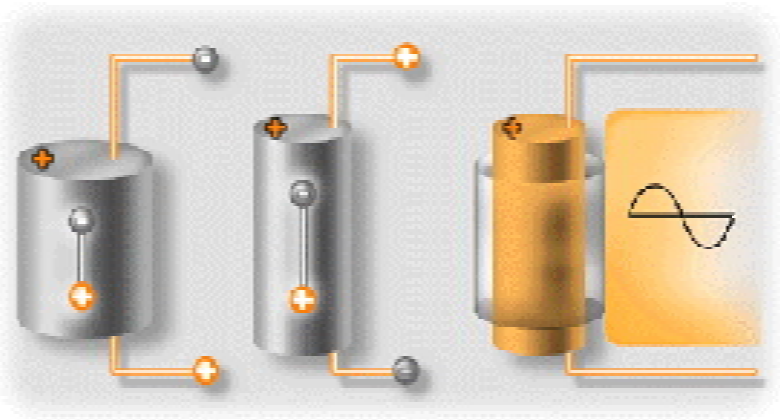
Noliac is specialized in a high degree of customization

The Piezoelectric effect

- Direct effect (sensor function)



- Converse effect (actuator function)



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Amplified actuator
for Active Vibration Control

References:

- IMechE conference, London 2009
- Actuator, Bremen 2010

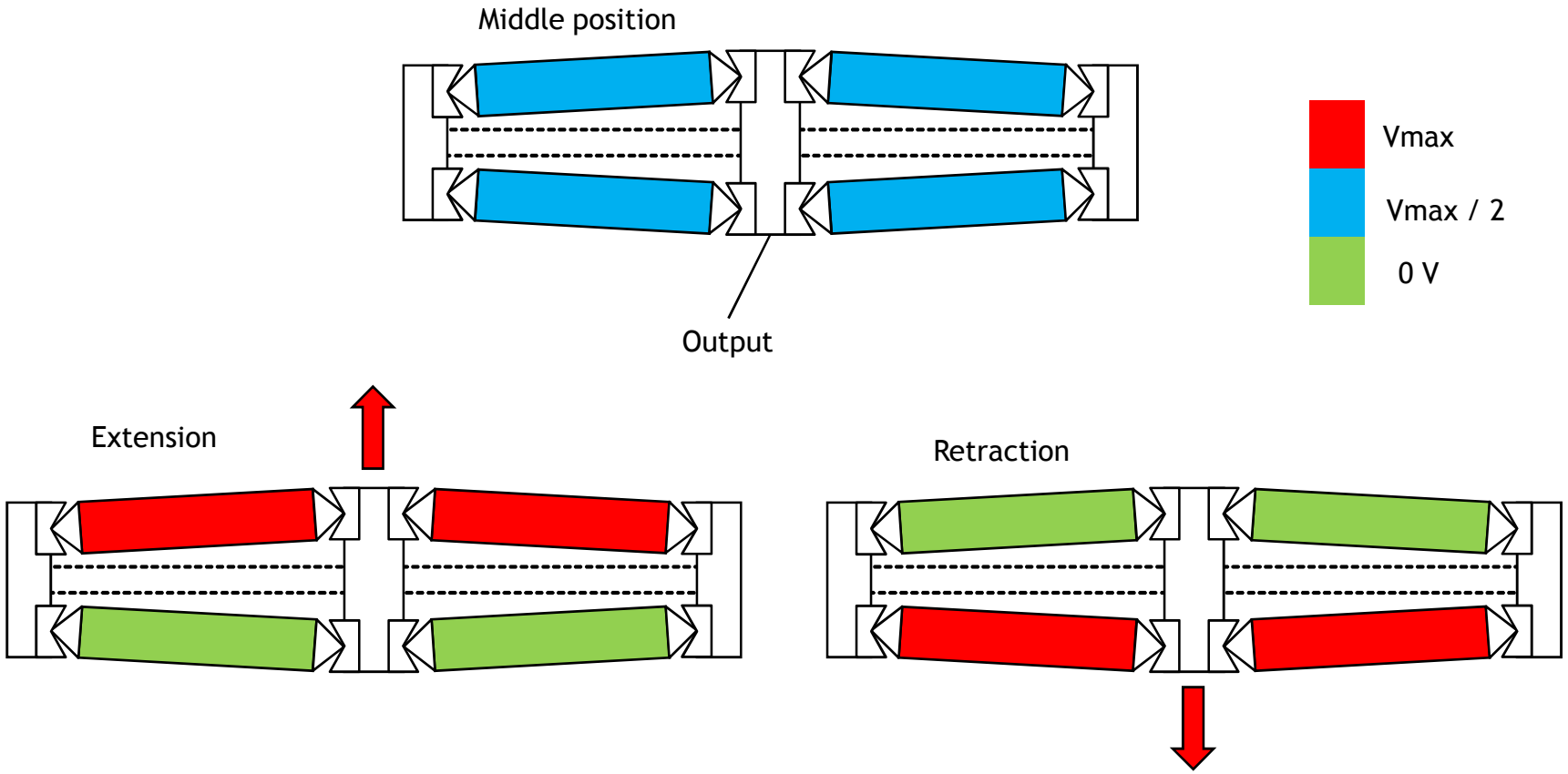
Amplified actuator - Background

- Active rotor control
- REACT project
- UK Technology Strategy Board (TSB) funded

Amplified actuator – Requirements

- High frequency (30 – 50 Hz)
- Small displacements (mm range)
- High force capability (several 100N)
- Environment
  - Centrifugal loads
  - Temperature
  - Vibrations…
- Optimised mass for a given performance
  - Energy density

Operating principle

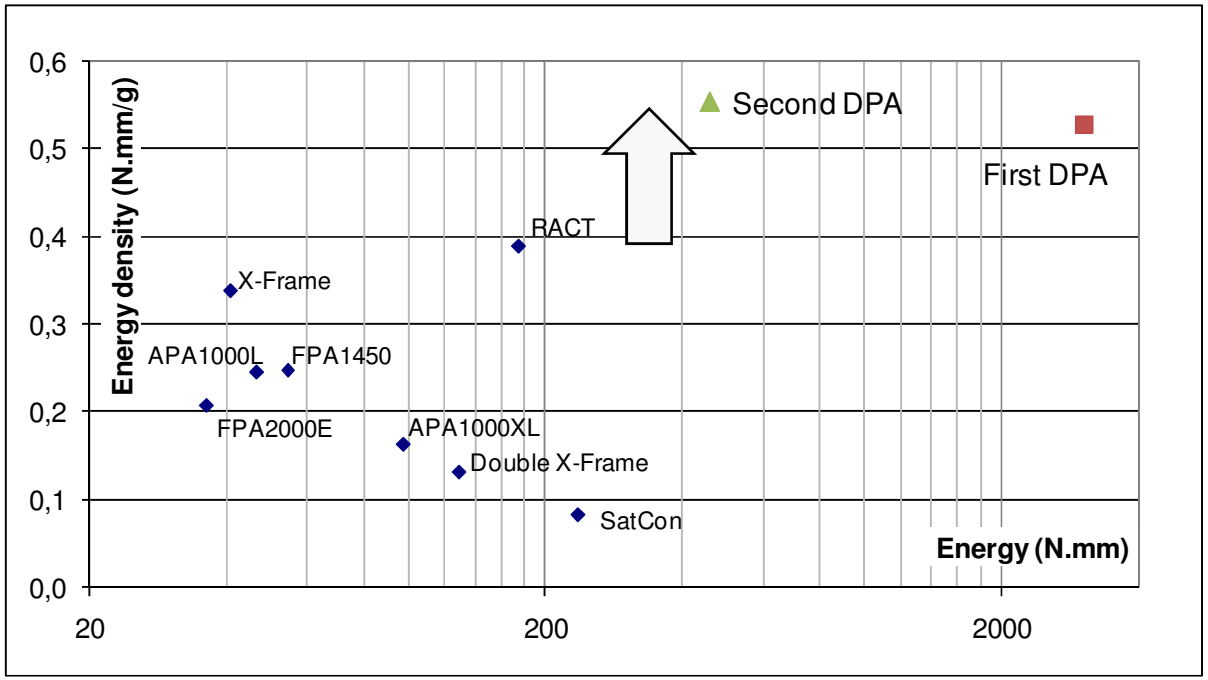


Construction

- Lightweight materials
- Compact assembly

Results: Energy density

- 35 to 42% improvement compared to state of the art



Advantages

- Preloaded structure
- Large proportion of active material
- Simple mechanical parts
- Temperature stable
- Low inertia – high bandwidth
- Stable middle position

Applications

- Active vibration control
- Primary / secondary surface control
  - High speed applications
- Direct drive valves

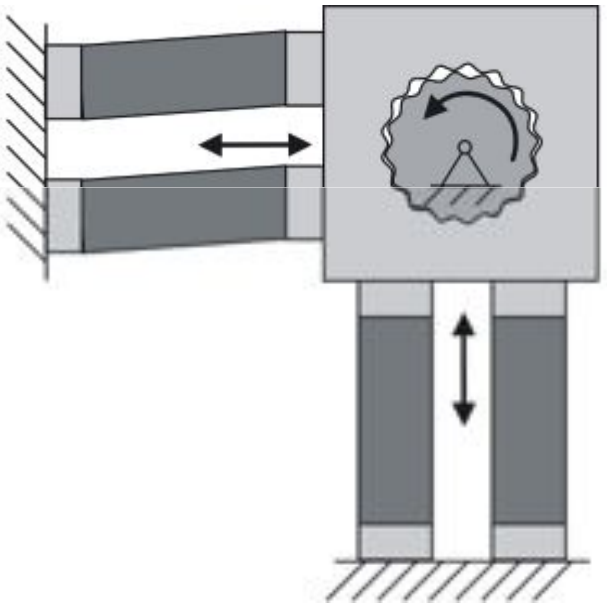
Piezo Actuator Drive (PAD)

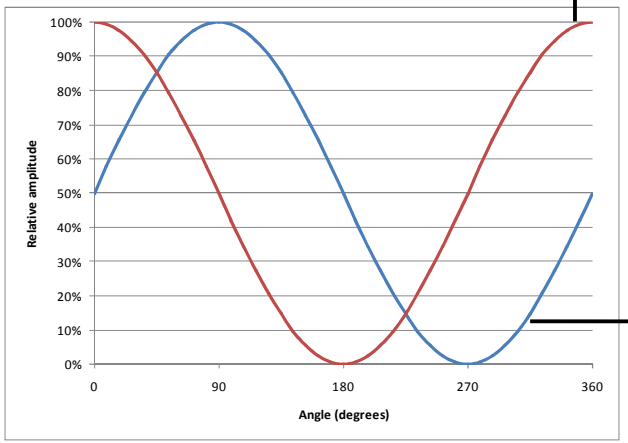
PAD technology transfer

- PAD – Piezoelectric Actuator Drive
- Developed by Siemens 2000 - 2008
- A partner needed for commercialisation
- Noliac A/S acquired the PAD technology from Siemens AG in 2010
  - Patents
  - Fully equipped test laboratories
  - PAD prototypes and demonstrators
  - Training of engineers
- Motor currently being developed for Siemens

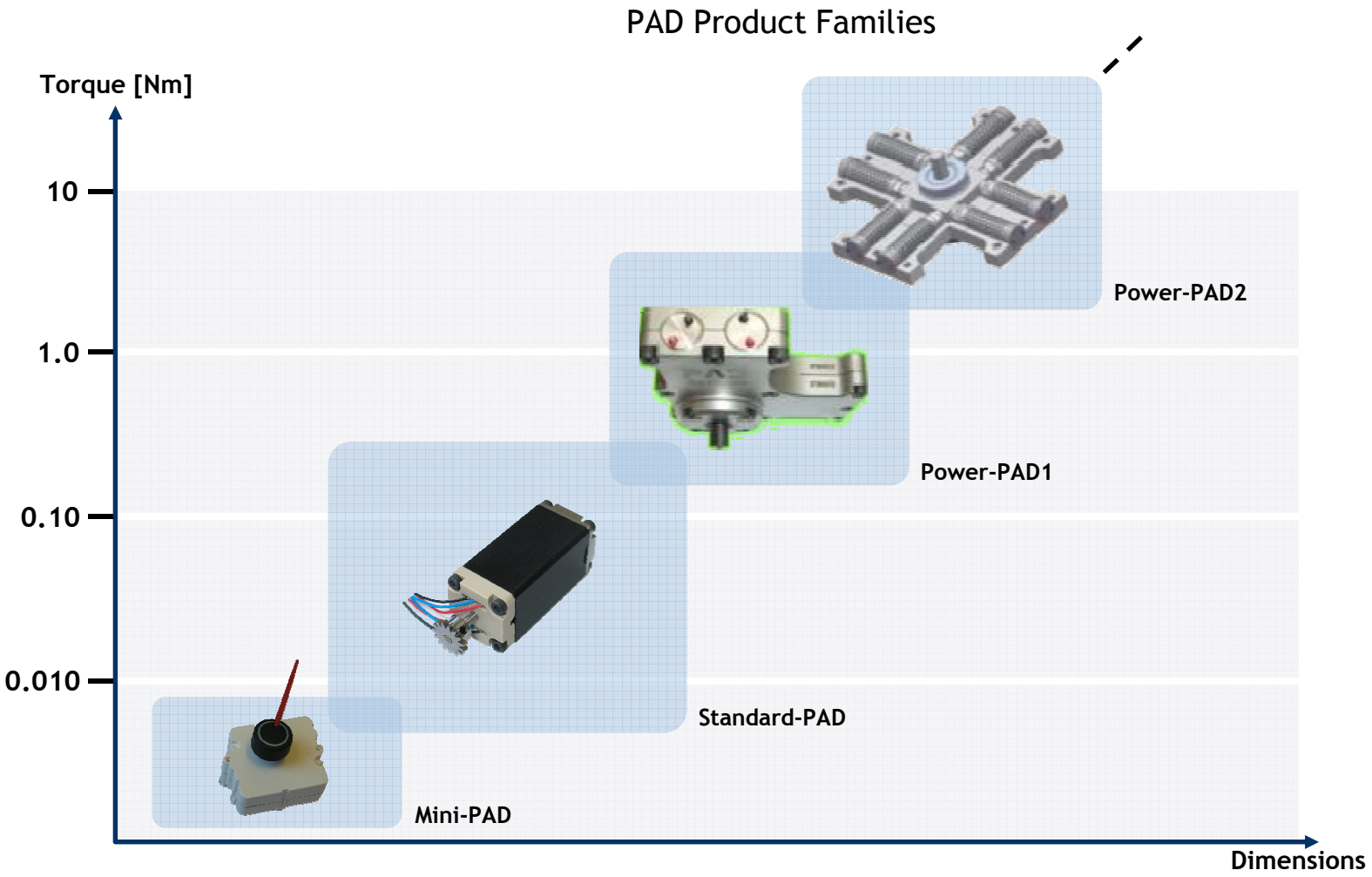
PAD principle

- Implementation:
  - Displacement generated by piezo elements
  - Signals with 90° phase

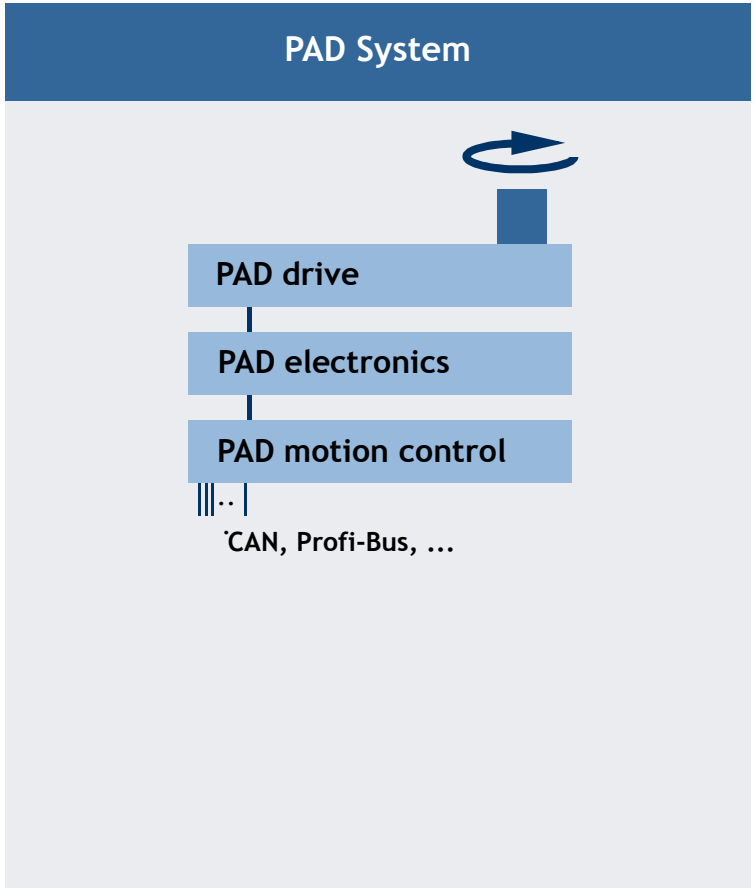


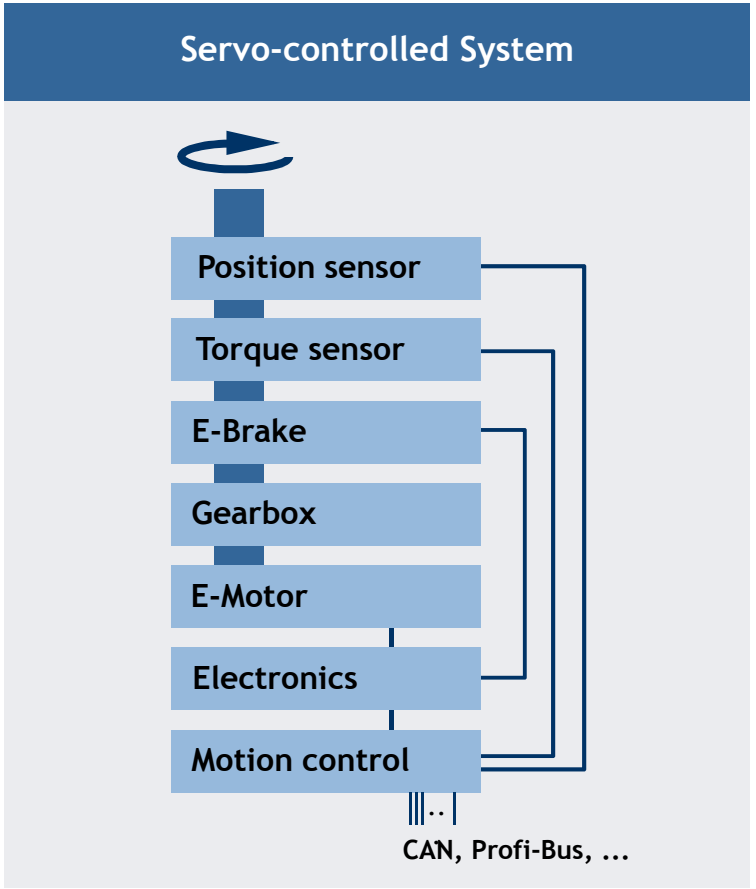


PAD – A Scalable Technology



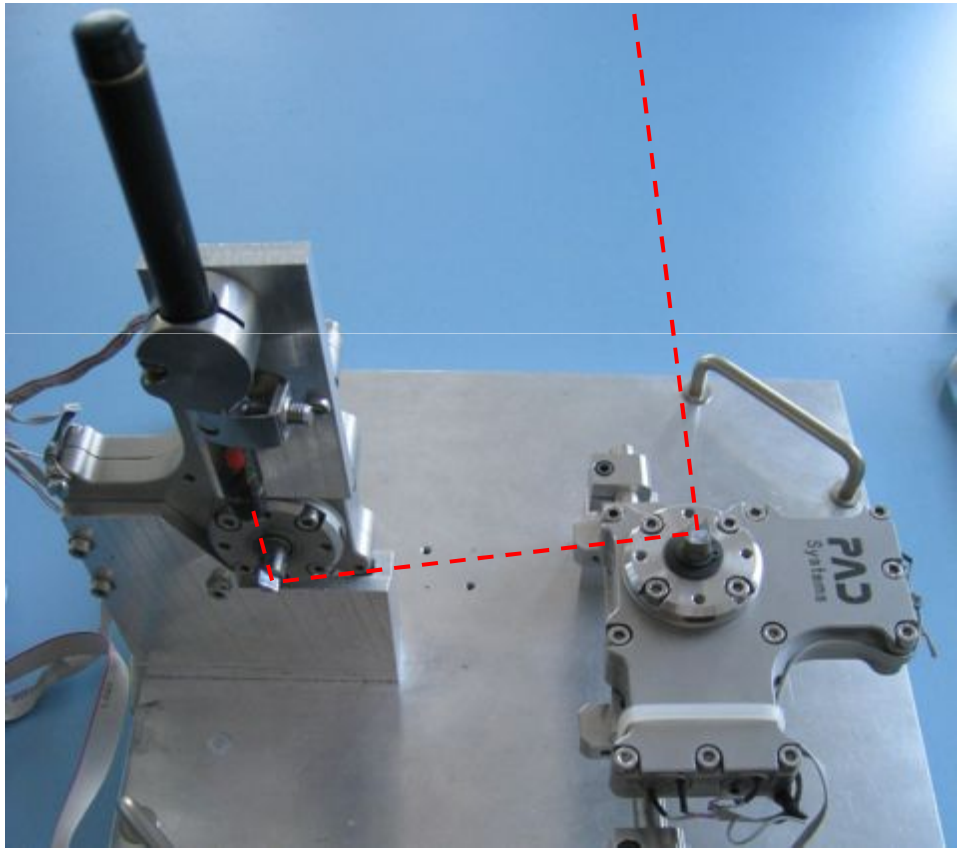
PAD – Reduced Complexity





PAD demonstrator: Beam steering

- 2 axes
- 1 PAD motor per axis
- No additional gearbox
- No feedback system
- 1 control box
- Synchronised movement



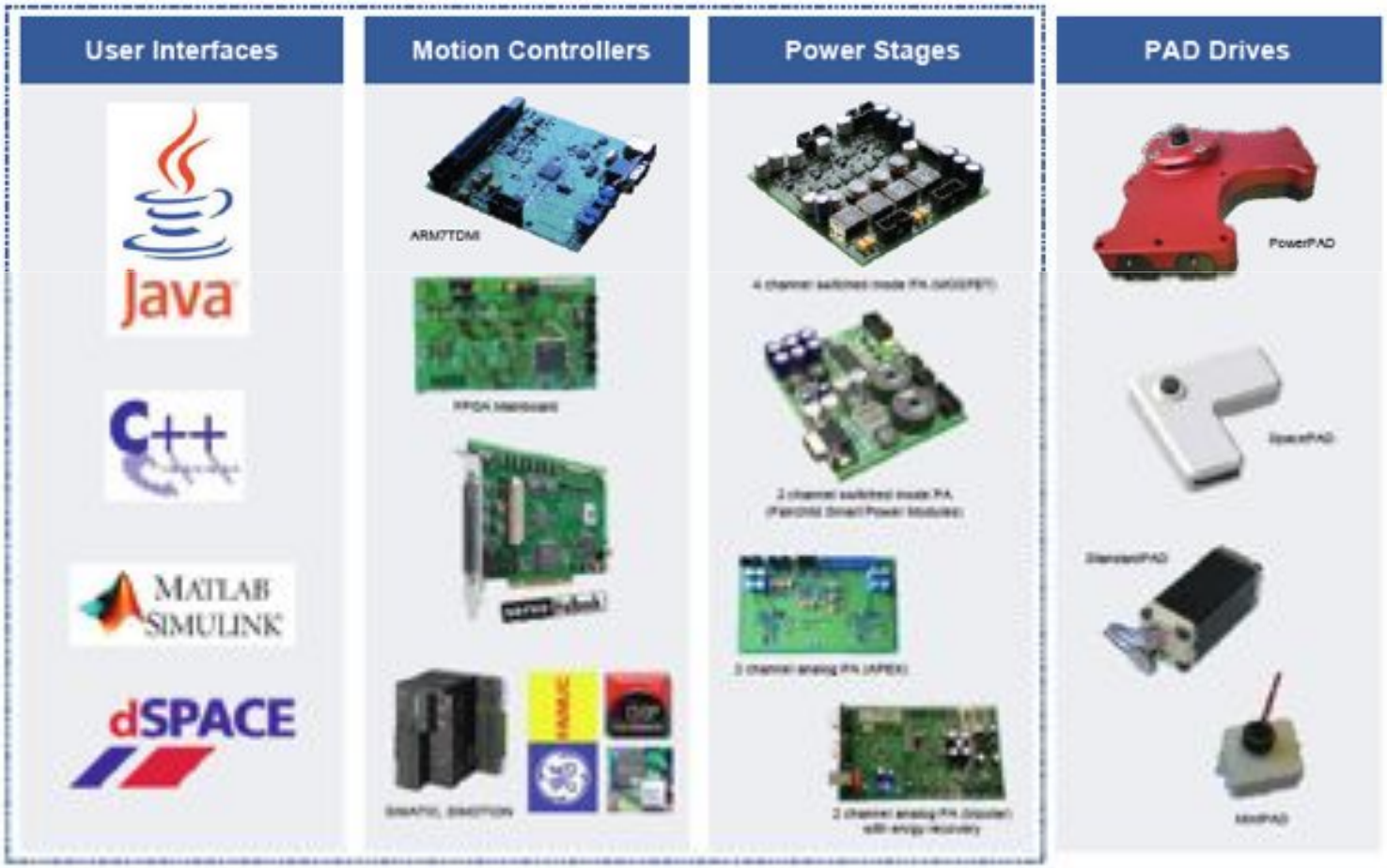
PAD demonstrator – Beam steering

- Key motor performance
  - Repeatability < 2 arcseconds
  - Step size 0,3 arcseconds
  - Speed up to 60rpm
  - <1ms to full speed

PAD motor characteristics

- Characteristics of interesting
  - Smart load sensing without torque sensors
  - High torque without gearbox (typ. 6,5 Nm)
  - Overload protection
  - No power consumption when holding a load
  - Not affected by strong magnetic fields
  - No magnetic stray fields

PAD System components and configurations



PAD – Other applications

- Antenna adjustment
- Servo valve
- Fin control

Conclusions

- Increasing interest in piezo solutions
- Continued research
- Increasing capabilities
  - New solutions
  - New processes
  - Make your system:
    - Smarter
    - Smaller, lighter
    - More effective

Thank you for your attention

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