

# Current Challenges in the Design of Drives for Robot-Like Systems

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1. Introduction to robot-like systems
2. Two Use Cases of robot-like systems
3. Classification of requirements on robot-like systems
4. Summary and Outlook



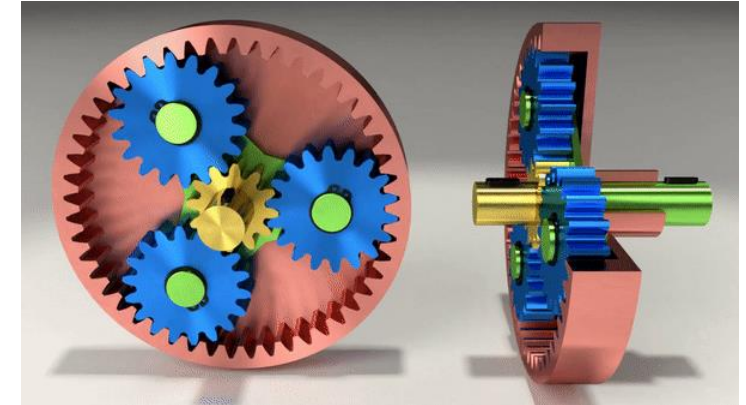
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## Robot-Like Systems (RLS) are

*"intelligent machines and systems used, for example, in space exploration, human services, or manufacturing"*

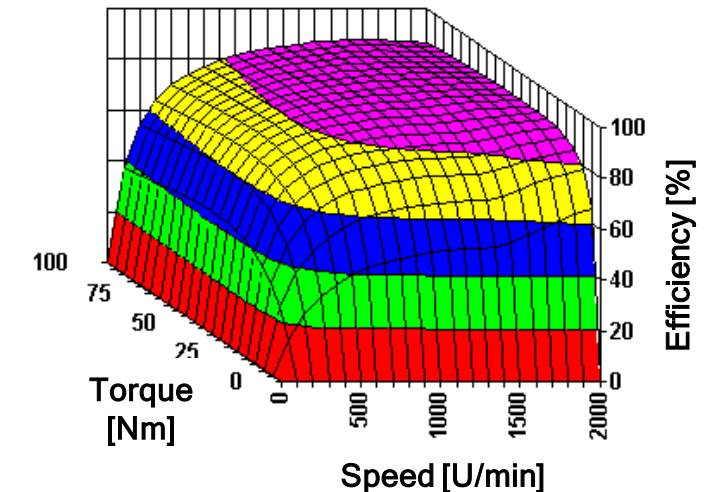
- Robotics and Automation Society



<https://www.tec-science.com/wp-content/uploads/2018/09/de-planetengetriebe.mp4>

## Challenges regarding design of RLS

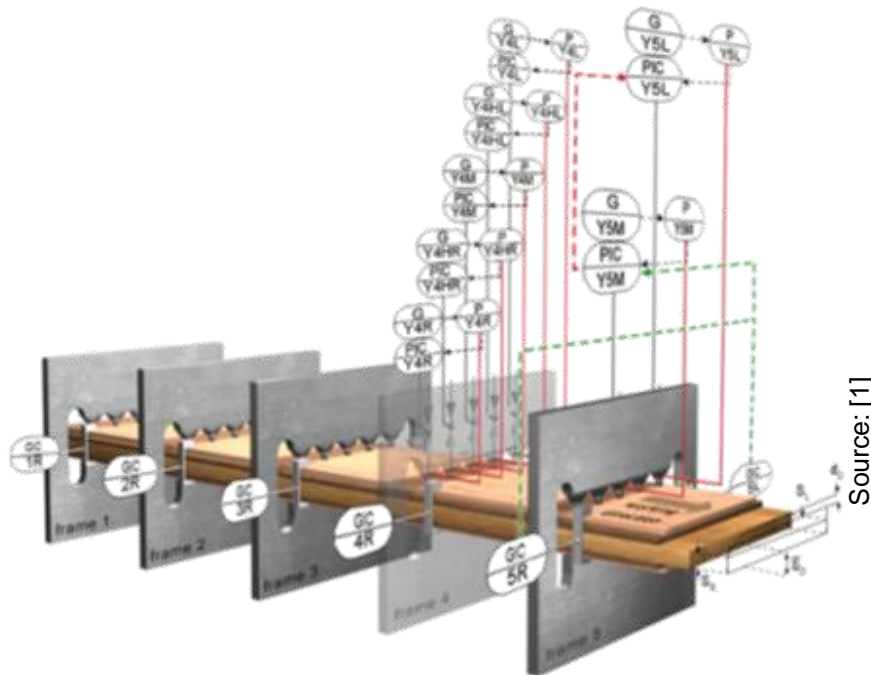
- Increased efficiency in design and production of RLS
- RLS behavior influenced by environmental factors (humidity)
- Counteraction only possible with knowledge of components



# Use Cases of Robot-Like Systems

## large-scale plant for cutting chipboards

- Continuous press line with thermohydraulic press
- Synchronous operation of 15 drives
- Precise synchronization essential for production process
- Sensitive to temperature, air humidity, wear



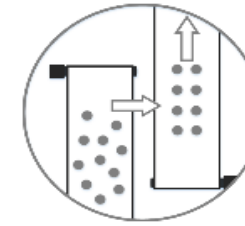
## multi-axis articulated robot arms

- Coordination of several axes
- Gearbox design matches application precisely
- Exact positioning despite high payload
- Fluctuations due to vibrations poor quality



### Horizontal jointed-arm robots

- Transport and sorting, quick movement and high precision
- Accuracy decrease over lifetime: time-dependent offset regarding homing position
- Frictional vibrations (stick-slip-effect) not readjustable with conventional control methods



Transport with very precise positioning



SCARA robot

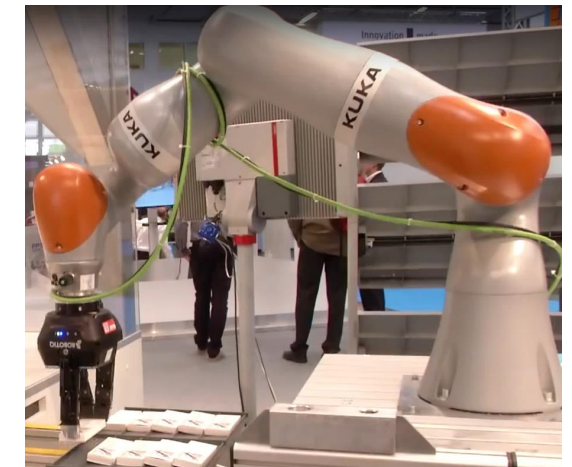
Source: epson.com

### Jointed-arm RLS with more degree of freedom

- Transport along flexible, predetermined trajectories
- End effector position measuring expensive and complex
- New transmission concepts lead to uncertainties
- Oversized solutions expensive



Flexible trajectories

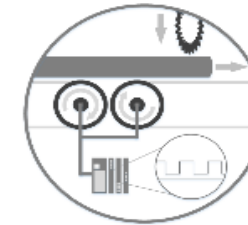


Source: Project RIAN

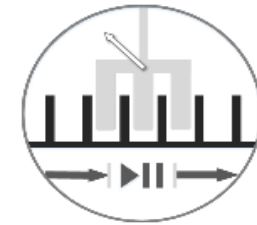
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### Discrete work piece production

- clocked synchronization and clocked interlocks
- Property change upon material replacement
- Performance influenced by mechanical and environmental effects
- Timing behavior readjustment needed



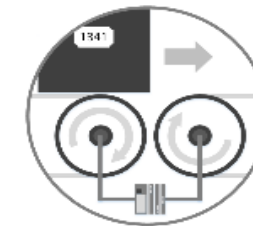
clocked  
synchronization



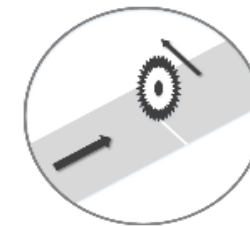
clocked  
interlocks

### Hybrid processes

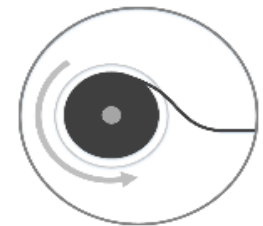
- Synchronization of several axes
- Cooperation of different disciplines
- Component Selection and system architecture influence real-time-capability
- Complex electronic components
- Error-proneness due to environmental conditions
- Compensate hardware by software functionality or extension



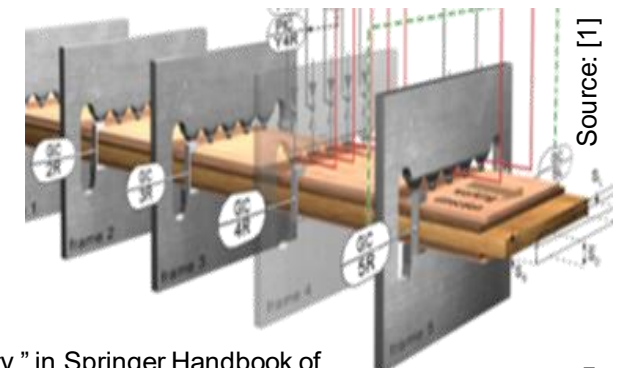
parallel  
synchronization



orthogonal  
movements



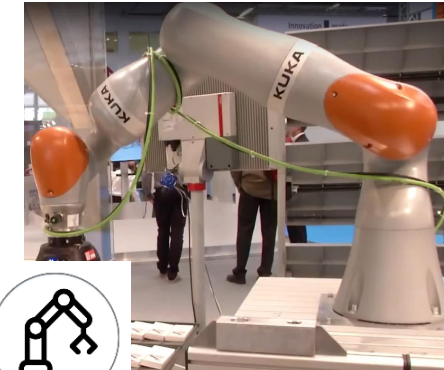
winding



Source: [1]

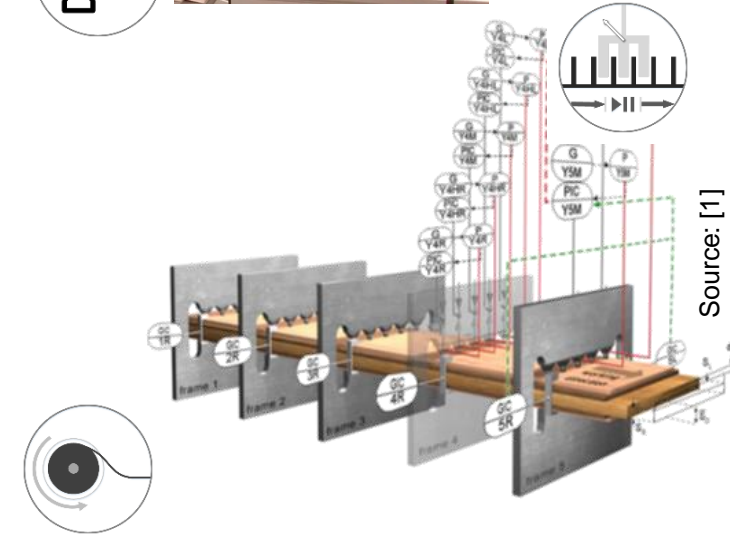
## Summary

- Overview on different drive systems, requirements and current challenges
- Similar challenges despite heterogeneous application and characteristics



## Outlook

- Thorough description of components and interdisciplinary dependencies
- Language to map discipline-specific views required
- Assistance in cost-efficient component selection
- Predictive adjustment of hardware changes (e.g. wear) by software functionality



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**Thank you for  
your attention!**



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