22 Requirements for Generating Learning Environments for Autonomous Systems Behavior in a Digital Continuum

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Background and Motivation

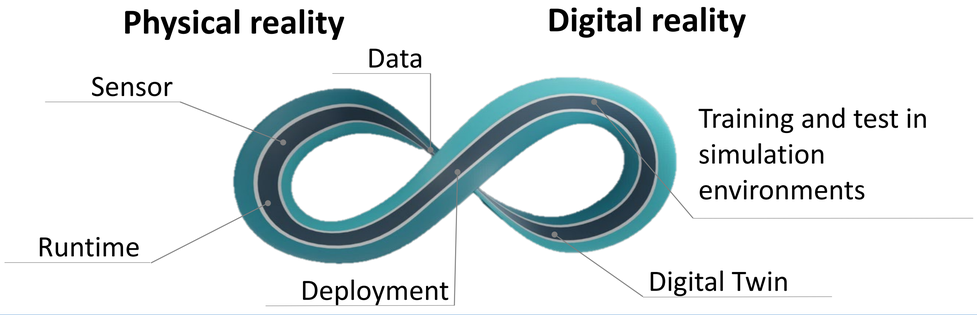
- Autonomous systems are increasingly prevalent in logistics, offering benefits such as flexibility, adaptability, robustness, and sustainability [1] [2]
- Challenges of the paradigm shift from centralized organizations towards autonomous systems:
  - Development of truly autonomous systems [3]
  - Requirement of new methods and concepts to find overall system behavior [1]
- New methods of artificial intelligence (AI) are seen as a solution, but:
  - Example autonomous mobile robots (AMR): current approaches of deep reinforcement learning in robotics are far from being able to train robots that can handle the complexity of environments in the real world [4]
  - The alignment problem in AI needs to be addressed [5]

Research Question 1

- How does a concept emerge that enables the development and operation of truly autonomous systems based on methods of AI?

Digital Continua

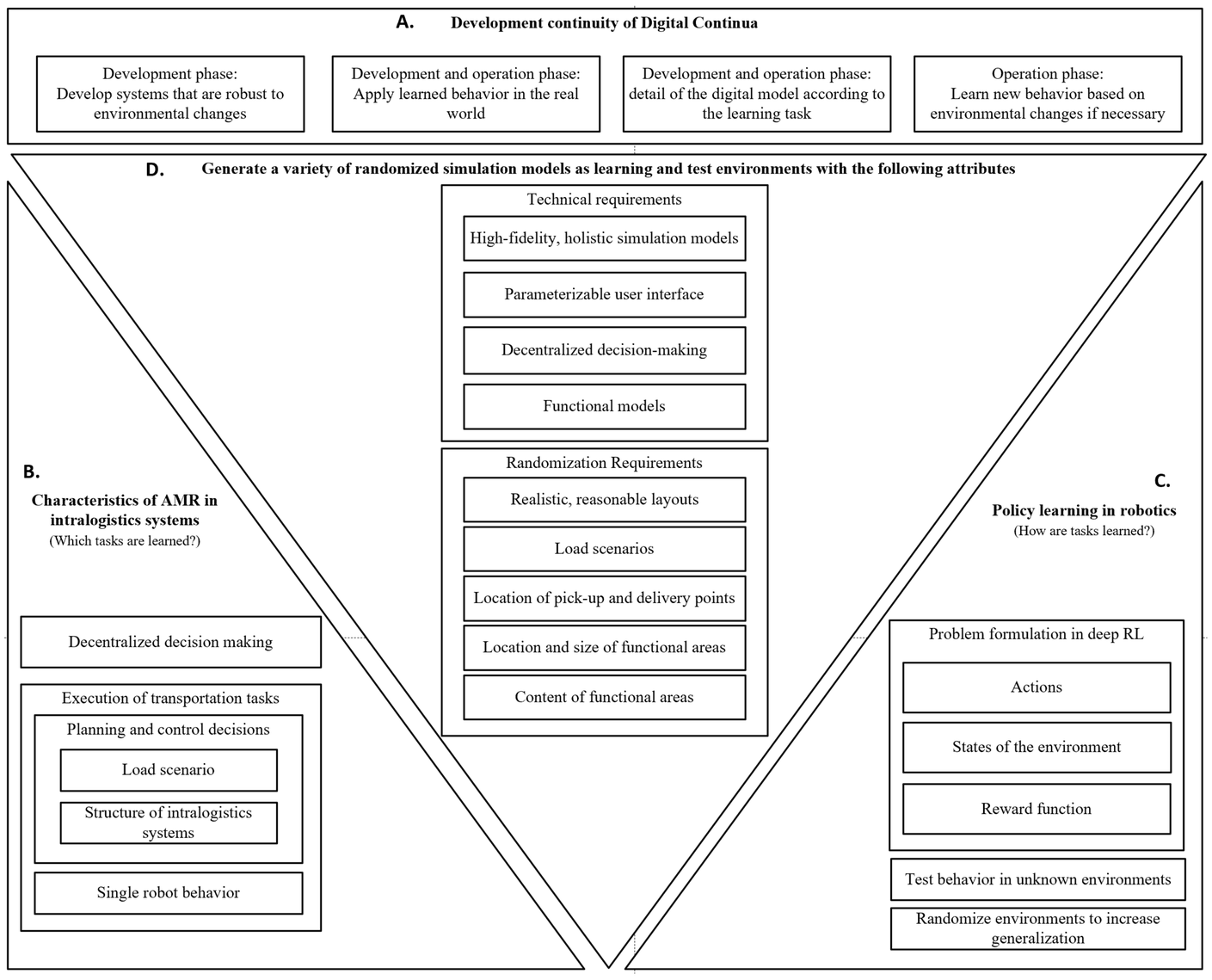
- ... arise when physical and digital reality combine to form a self-optimizing control loop of AI and interact with each other.
- … accelerate planning, development and implementation processes.
- ... blur planning and execution phases.
- ... lead to highly adaptive systems that adapt resiliently to changing requirements.



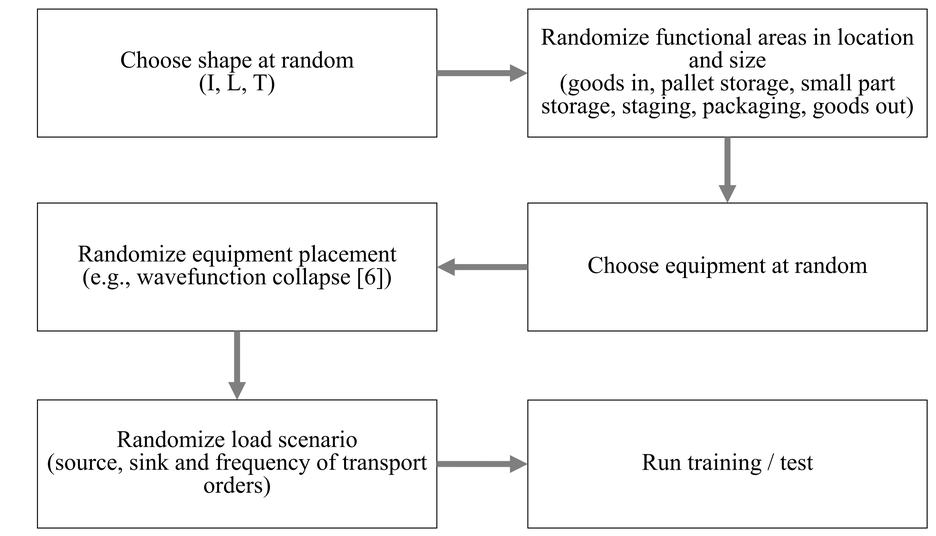
Research Question 2

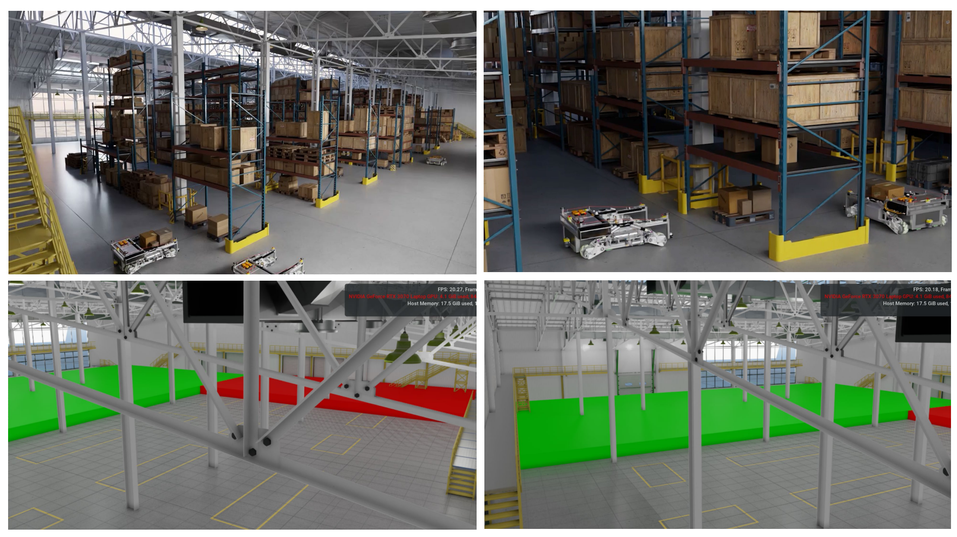
- How can the required great variety of learning environments for autonomous behavior in intralogistics be generated automatically?

Requirements for a Generation Approach



Generation Approach





Conclusion and Outlook

- The Digital Continuum paradigm offers a promising approach by leveraging the seamless fusion of physical and digital reality to achieve a new level of autonomy through AI-based methods.
- Digital learning and testing environments will become the central tool to revolutionize the continuous development of intralogistics systems even during operation.

Literature

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