


TNO innovation for life

Mapping Autonomy

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Applications of autonomy

- Mobility
  - More autonomous and more cooperative vehicles.
- Military Vehicles
  - Underwater mine hunting
  - Swarms for surveillance
  - Frigate autonomy
  - Frigates cooperating in a task group
  - Meaningful human control for LAWS


Developments in Autonomy: Automation

- Algorithms for Situation assessment
- Algorithms for Situation management

- Developments: dealing with more complex situations and better cooperation between autonomous systems

- Advantages: fast, transparent

- Disadvantage: not dealing well with failures and unexpected situations


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Developments in Autonomy: Learning

- Online learning (learning on the job)
- Offline learning (training)

- Developments: faster learning (faster computers, efficient algorithms)
- Advantages: very flexible tool
- Disadvantages:
  - still very slow for complex systems in complex situations
  - difficult to understand how it works and why it works
  - inherently unpredictable and more easy to deceive (online)
  - not dealing well with failures and unexpected situations (offline)


Role of the human

- Cooperation with autonomous system on situation assessment and situation management
- Fail-safety agent
  - When the autonomous system is failing the human intervenes.
- Moral agent
  - The human makes moral decisions and intervenes when autonomous system does not act in a morally acceptable way.


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Developments in Autonomy: self-determination

- It involves self-assessment
  - What are my resources: sensors, computation, communication, actuators?
  - How well am I doing?
- And self-management
  - Now that I know and understand myself and my environment how should I manage myself in order to reach my goals?
- Advantages
  - Faster than learning
  - Can deal with failures and unexpected situations
  - Can explain what it is doing


Role of the human revisited

- Better cooperation with human on situation assessment and situation management
- Cooperation with autonomous system on fail-safety
  - When there are failures in the autonomous system, it is aware of its failure and can reason how to deal with this.
- Cooperation with autonomous system on moral issues
  - When ethical goals are formulated properly the autonomous system can pursue these goals.


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Considerations on ethics of autonomy

- Self-determination is an important aspect of autonomy for cooperation with humans on fail-safety and moral issues.
- Ethical goals (and rules) should be consistent and explicit
  - There is often reluctance in making these goals explicit
- Humans should acknowledge the limitation of their own minds
  - Cognitive constraints, cognitive biases, cultural differences
- The deeper problem that needs to be addressed in autonomy for LAWS is the control of autonomy itself.