



UNIVERSITY
OF TRENTO - Italy

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Final Event
Aachen, Germany
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Adapt://*Ve*

*Automated Driving Applications and
Technologies for Intelligent Vehicles*

*Modelling an artificial driving
agent inspired to the human
sensorimotor system*

A photograph showing a person's hands on a steering wheel inside a car, wearing a light blue striped shirt and blue jeans.

// Contents of the talk

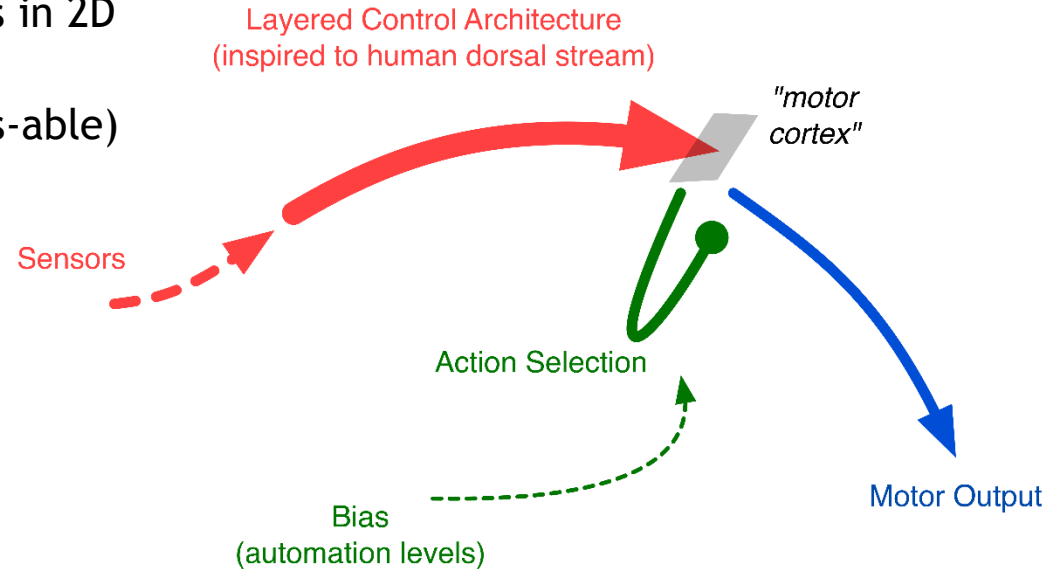
- **Efficient cognitive architectures for optimal behaviours**
 - Notion of affordances and action selection
 - Bio-inspired agent layered control architecture
- **Examples of safe behaviours that emerge from affordance competition**
 - Traffic light with late pedestrian crossing
 - Adaptation to intersecting traffic (2 sub cases)
 - Merge, Overtake, Cut-in
- **Conclusions**
 - Advantages of the implemented architecture
 - Future work

// Optimal behavioural planning

- **Notion of affordances**
 - In every situation there are action possibilities latent in the environment (called affordances)
 - The goal is to dynamically select the “optimal” strategy
 - For example, driving often requires choosing between alternative strategies (especially in urban scenarios), to maximize opportunities (efficient flow) and minimize risks (safety)
- **Bio-inspiration**
 - Nature solved the problem of optimal behavioural planning with a particular architecture of the brain that implements competition between affordances
 - We have implemented a similar mechanisms

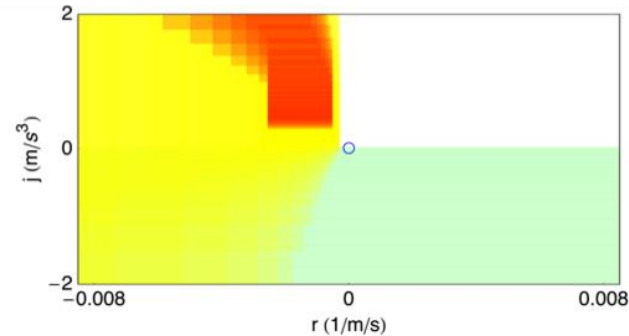
// Artificial driver architecture

- Parallel simultaneous priming of all possible actions (red arrow)
- Representation of possible actions in 2D space
- Actions selection mechanism (bias-able)



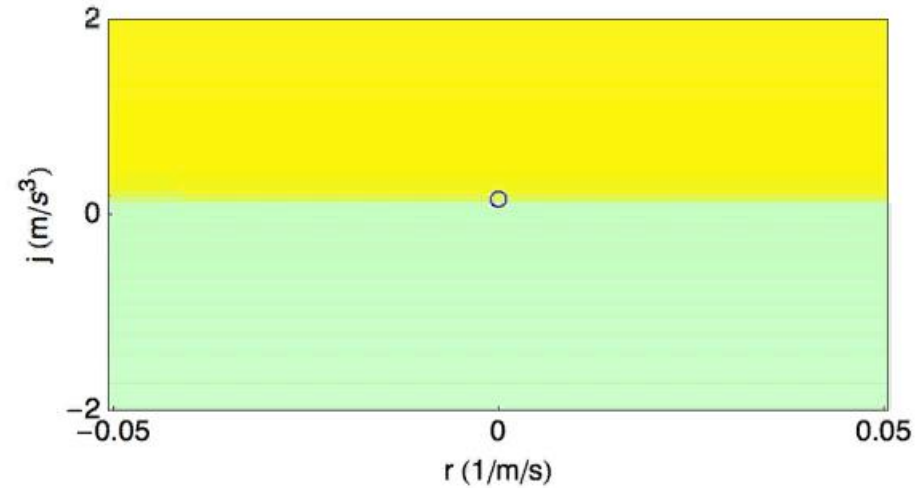
// Topographic representation of actions

- **Driving means controlling two-degrees of freedom.**
 - We may locate all possible action in the 2D instantaneous control space, which is analogous of topographic representations that exist in human motor cortex.
 - Inhibition mechanism suppresses actions that could lead to collisions (implicit safety)
 - Algorithms (e.g.WTA, MSPRT, etc.) may be used for optimal action selection



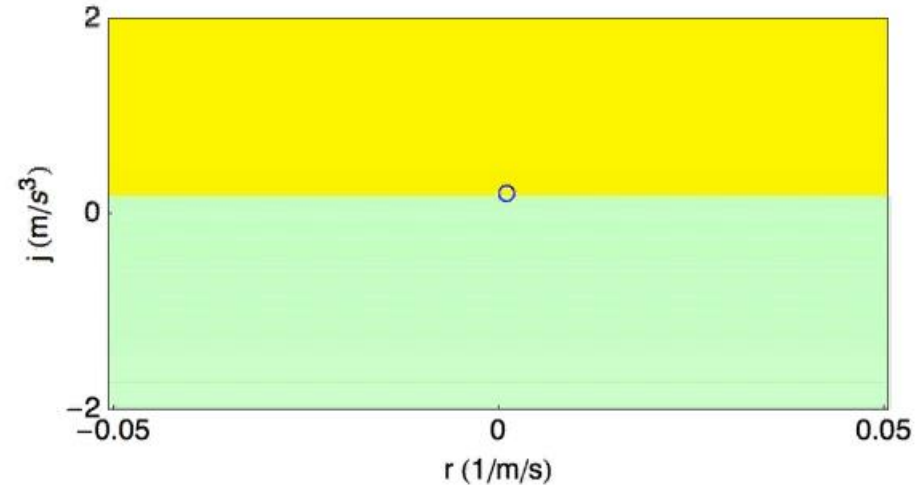
// Example 1

- Traffic light with late pedestrian crossing



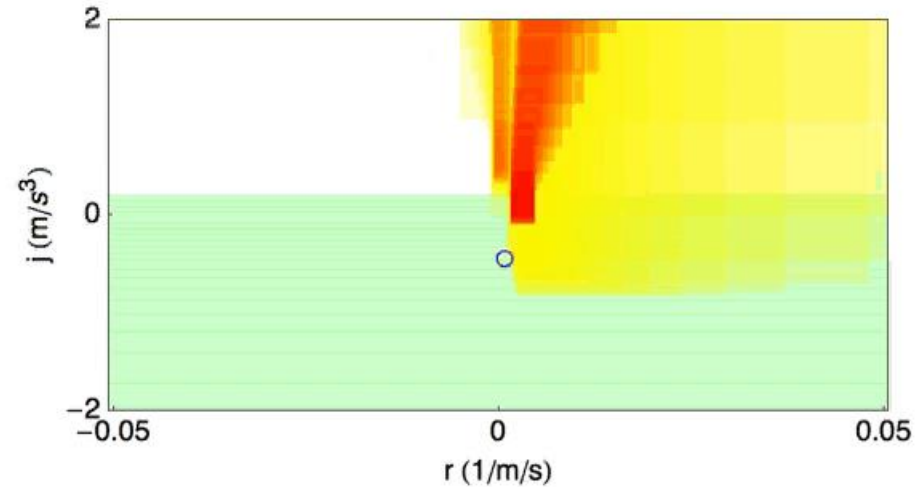
// Example 2

- Adaptation to intersecting traffic



// Example 3

- Merge, Cut-in, Overtake



// Conclusions

- **A bio-inspired agent architecture has been implemented to deal with variable dynamic complex situations**
 - Behaviours emerge from competition of affordances
 - Inhibition mechanism suppress dangerous manoeuvres
 - The architecture is rather simple compared to the complexity of behaviours that it can generate
- **Future work**
 - System may be implemented with DNN (integrated with perception)
 - Training can be carried out offline (to certify the agent)
 - System can be used to mirror human drivers and enable human-vehicle interactions similar to human-human interactions



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Thank you.

