Practical design of minimal energy controls for an electric bicycle

Grossoleil, David, and Dominique Meizel. "Practical design of minimal energy controls for an electric bicycle." 9th International Conference on Modeling, Optimization & SIMulation. 2012.

Approach

- Discretization of search space
- Build search graph
- Use A* to find minimal cost path
- Use heuristic based on friction, air drag, kinetic energy and potential energy

Deficits

- Graph search approach requires discretization of search space
- The higher the rate of discretization, the more complex (especially space)

Contributions

- Drastically reduced the search space for graph search approach

Explicit fuel optimal speed profiles for heavy trucks on a set of topographic road profiles

Froeberg, Anders, Erik Hellstroem, and Lars Nielsen. Explicit fuel optimal speed profiles for heavy trucks on a set of topographic road profiles. No. 2006-01-1071. SAE Technical Paper, 2006.

Approach

- Usage of a physical model to derive efficient driving behaviour
- Take model situations compute the optimal fuel supply
  - level road
  - small gradients
  - high uphill slopes
  - high downhill slopes

Deficit

- Not applicable to unknown tracks

Contribution

- Optimal control can be achieved using only three different motor controls
  - Roll
  - Speed
  - Cruise

Evolving Look Ahead Controllers for Energy Optimal Driving and Path Planning

Gaier, Adam, and Alexander Asteroth. "Evolving look ahead controllers for energy optimal driving and path planning." Innovations in Intelligent Systems and Applications (INISTA) Proceedings, 2014 IEEE International Symposium on. IEEE, 2014.

Approach

- Use evolved neural network for energy efficient vehicle control in simulation
- Use simple, but continuous model
- Use only three commands: Roll, Speed, Cruise
- Use SOA approach NEAT
  - Optimization of topology and weights of a neural network
  - Starts with minimal topologies and complexifies them
  - Uses special form of cross-over operator
  - Promotes novel solutions

Deficits

- Proof of concept evaluated in simulation $\rightarrow$ Probably has to be modified to be usable in reality (Reality Gap)
  - Use more detailed models of vehicle and environment
  - Use transferability approach

Contributions

- Controller that is adaptable and has a very low space complexity