Kickoff - Proseminar
“Design of an automatic bicycle”

Dr. Daniel Renjewski, Dipl.-Ing. Gereon Hinz
13.10.2015, TUM
## Participants

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Motivation - Why bikes? Why automated?

- **Bikes are great!**
  - Convenient, space preserving, health enhancing and eco-friendly means of transport for short and medium distances

- **It's possible!**
  - Modern sensors, actuators and microprocessors are sufficiently cheap and powerful and can be combined with sophisticated computer vision, data-fusion and path planning

- **It useful!**
  - Automation technology can protect you and your bike in dangerous situations (blind spot warning, obstacle detection...)
  - Automation technology can extend the group of bike users to include elder and untrained people (stabilization...)
  - Automation technology can transport things without your help and make sure your bike is where you need it to be!
  - ...

**Questions:** What can automation do to make bike riding safer and more enjoyable? How can it be done? What infrastructure is necessary? What are the challenges? What is already there?

**Goal:** Develop an understanding of the current state and potential of automated bikes while improving your scientific writing and presentation skills.
Proseminar Tasks

• Get motivated! Develop a passion for (automated) bikes!

• Choose one of the available topics (1 student per topic), discuss with tutor

• Perform literature research (exhaustive!) and write survey paper (quality!)

• Get a review for your paper, submittion by early December (Renjewski/Hinz). Update if necessary until acceptation (~December 2015).

• Design a poster and give a presentation (~January 2015)
Discussion: Automated Bikes

- Experiences with the topic?
- Bicycle accidents?
- Cultural perspective?
- Limits of technology?
- Limits of infrastructure?
- New use cases?

Ein Fahrer, zwei Fahrräder – ist das erlaubt?
http://www.badische-zeitung.de/freiburg/ein-fahrer-zwei-fahrraeder-ist-das-erlaubt--18547543.html

Research Topics

1. Challenges and state of the art
2. Market potential and customer demands
3. Crowd science and crowd funding - introduction of new technologies
4. Simulators and bicycle dynamics
5. State estimation - specific challenges in bicycles
6. Required functions for bike-automization
7. Impacts on infrastructure
8. Technical challenges to cost effectiveness and device safety
9. "Related bikes" - 2 wheel, 3 wheel, 4 wheel solutions
1. Challenges and state of the art

• What are the challenges of riding a bicycle?

• What assistive technologies have been developed so far?
  • product survey
2. Market potential and customer demands

• What would be required of an automated bicycle in order to find customers?

• What are likely target groups?
3. Crowd science and crowd funding - introduction of new technologies

- How can modern automation technologies be introduced, utilizing crowd science and crowd funding possibilities?


https://www.kickstarter.com/projects/1106460188/smarthalo-turn-your-bike-into-a-smart-bike/description
4. Simulators and bicycle dynamics

• What types of simulations and simulators are used to model bicycle physics?

• What are essential dynamic properties of bike riding
5. State estimation - specific challenges in bicycles

- What are challenges for environment perception and self-localization in general? How do they translate to bicycles? What are new challenges with regards to automated bicycles?


6. Required functions for bike-automization

• For automated driving a multitude of functions and components is required. Which components are required for autonomous bicycles and how do they work?

7. Impacts on infrastructure

• How does infrastructure influence the motivation to take a bike. What infrastructural challenges exist and could be solved by automated bicycles?
8. Technical challenges to cost effectiveness and device safety

• Conditions for using mobile devices for bicycle control in order to reduce cost and keep components safe. Problems of cheap devices?
• What components of mobile devices may be used for bicycle automation?


9. Related bikes - 2 wheel, 3 wheel, 4 wheel solutions

• Which types of bikes or similar vehicles are there and how could they be equipped with smart functions or automation?

Stepwise convertible tricycle toy https://www.google.com/patents/US5028066

Pfau Tec Bene Front-Dreirad
http://www.fahrradgigant.de/Fahrraeder/Dreiraeder/Pfau-Tec-Bene-Front-Dreirad-20-24-13::47421.html

"Solowheel" - https://www.youtube.com/watch?v=1wZbP1L1C2I
Presentation

• January (19.1.2016?, 180min)
• 10 min + 10 min discussion
• Minimal content:
  • Detailed problem statement
  • Researched solutions and approaches
  • Advantages and Disadvantages
  • Open Questions – Possible solutions.

Bachelor-/Master-thesis can extend the topics (perfect preparation)!
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• autombike2015

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