Kickoff - Proseminar
“Design of an automatic bicycle”

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

Video: Primer-v2 Robot Riding a Bicycle
https://www.youtube.com/watch?v=iXX1GQLukkI

Participants

		Topic
Pierre Louis	Bonvin	X
Neil	Neureither	X
Nitin	Deshpande	X
Ruocong	Shan	
Maksym	Dzitsiuk	
Robert	Lang	
Felix	Uhl	X
Philipp	Schmid	X
Eric	Luyken	

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

http://www.bibliophilin.de/wp-content/uploads/2009/09/Fahrrad-Parkplatz.jpg

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?
  - Jones, D. The stability of the bicycle. *Physics today* (2006)

- 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?
  - Rose, Geoffrey. "E-bikes and urban transportation: emerging issues and unresolved questions." *Transportation* 39.1 (2012): 81-96.

- What are likely target groups?
  - Dill, Jennifer, and Geoffrey Rose. "Electric bikes and transportation policy: Insights from early adopters." *Transportation Research Record: Journal of the Transportation Research Board* 2314 (2012): 1-6.

3. Crowd science and crowd funding - introduction of new technologies

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

Klippel, A., K. Sparks, and J. O. Wallgrün. "PITFALLS AND POTENTIALS OF CROWD SCIENCE: A META-ANALYSIS OF CONTEXTUAL INFLUENCES." *Proceedings, ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences (to appear) (2015).*

Stadler, Marius, et al. *Erfolg von Crowdfunding-Kampagnen frühzeitig erkennen: Erfolgsprädiktoren auf Kickstarter und Indiegogo*. No. 67871. Darmstadt Technical University, Department of Business Administration, Economics and Law, Institute for Business Studies (BWL), 2015.

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?
  - Hannas, Benjamin Lee, and John Eric Goff. "Model of the 2003 Tour de France." *American Journal of Physics* 72.5 (2004): 575-579.

- What are essential dynamic properties of bike riding
  - Jones, D. The stability of the bicycle. *Physics today* (2006)
  - Dong, O, Graham, C, Grewal, A & Parrucci, C. The bricycle: a bicycle in zero gravity can be balanced or steered but not both. *Vehicle System Dynamics* (2014).

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?

Stein, Fridtjof. "The challenge of putting vision algorithms into a car." *Computer Vision and Pattern Recognition Workshops (CVPRW), 2012 IEEE Computer Society Conference on*. IEEE, 2012.

Kelly, Alonzo, et al. "Toward reliable off road autonomous vehicles operating in challenging environments." *The International Journal of Robotics Research* 25.5-6 (2006): 449-483.

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?

Urmson, Chris, et al. "Autonomous driving in urban environments: Boss and the urban challenge." *Journal of Field Robotics* 25.8 (2008): 425-466.

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?
  - Akar, Gulsah, and Kelly Clifton. "Influence of individual perceptions and bicycle infrastructure on decision to bike." *Transportation Research Record: Journal of the Transportation Research Board* 2140 (2009): 165-172.
  - Dill, Jennifer, and Theresa Carr. "Bicycle commuting and facilities in major US cities: if you build them, commuters will use them." *Transportation Research Record: Journal of the Transportation Research Board* 1828 (2003): 116-123.

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?

Guido, Giuseppe, et al. "Estimation of safety performance measures from smartphone sensors." *Procedia-Social and Behavioral Sciences* 54 (2012): 1095-1103.

You, Chuang-Wen, et al. "CarSafe: a driver safety app that detects dangerous driving behavior using dual-cameras on smartphones." *Proceedings of the 2012 ACM Conference on Ubiquitous Computing*. ACM, 2012.

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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Ruocong	Shan	
Maksym	Dzitsiuk	
Robert	Lang	
Felix	Uhl	9
Philipp	Schmid	4
Eric	Luyken	

- Di um 10:00, 03.07.011 Roboterlabor, Kickoff Termin

- autombike2015

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