iCSC International Cycling Safety Conference
Dresden, Germany
8-10 November 2022

HS PF

The influence of an active steering assistance system on the cyclist's experience in low speed riding tasks

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Objectives and Motivation

Older cyclists have a higher risk of losing balance and having an accident on a pedelec than younger cyclists. Especially at low speeds, where maintaining balance on a pedelec is a challenging task. The cyclist must balance the bicycle by steering movements and/or weight shifting using the upper body. For older cyclists, declining physical and motor skills can limit these stabilizing movements.

A stability assistance system with an electric motor acting on the steering shaft provides steering assistance and helps stabilizing the pedelec.

However, the steering interventions might affect the cyclist and the riding experience.

Using a steer assisted pedelec, this study investigates the influence of these interventions on the cyclist and his riding experience at low speeds.

Methods and Test Procedure

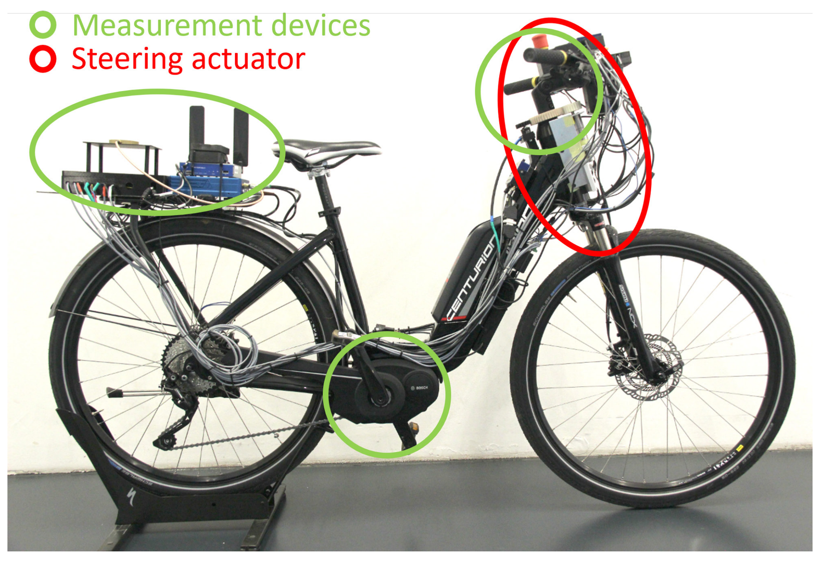
A field test with 30 men and 30 women between 59 and 84 years of age was conducted. Each participant completed a riding task using an instrumented pedelec with steering assistance. The riding task was performed with activated and deactivated assistance system.

Participants were asked to compare their ride with the previous one.

To evaluate the stability of the pedelec, measurement data were recorded during each test ride.

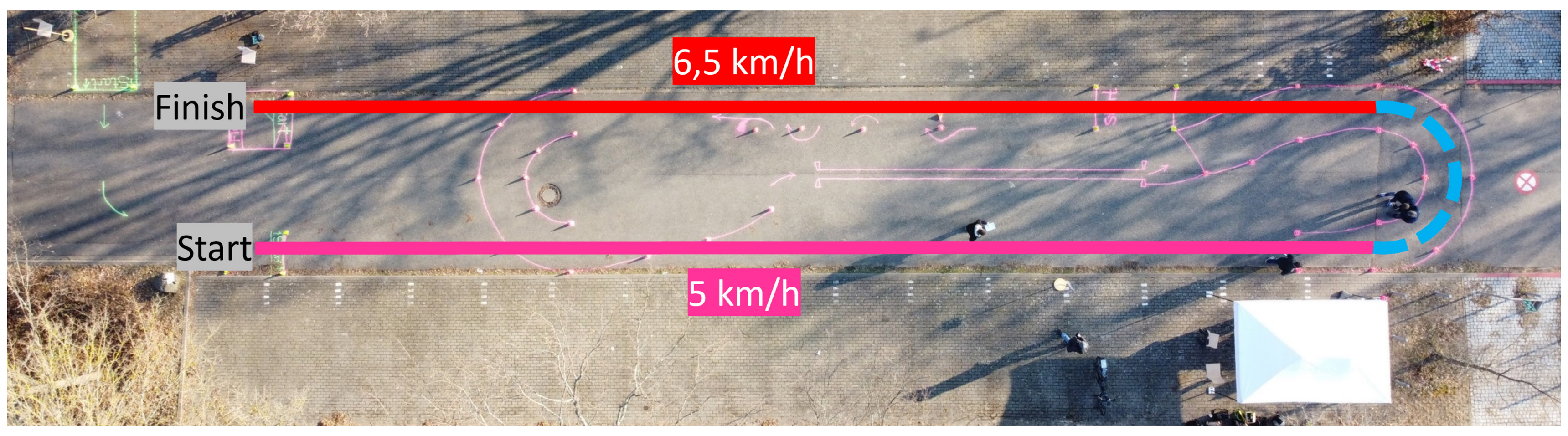
Instrumented Pedelec

- An electric motor applies **a torque to the steering shaft** turning the handlebars slightly in the direction the bicycle leans **(Steer into the Fall).**
- The system operates in three different configurations.
- In **C0** the system is deactivated.
- In **C1** balancing is supported with low steering torque.
- In **C2** balancing is supported with higher steering torque.



Stability related measurements were recorded during the test rides to evaluate the stability of the pedelec:
roll angle, roll rate, steering angle and steering rate.

Riding Task



The riding task consisted of three sections:

1. The cyclist had to ride straight ahead at 5 km/h,
2. turn around in a curve,
3. then ride back straight ahead at 6.5 km/h.

The task was repeated nine times, three times with each configuration. After the ride the participant was asked to compare the current ride with the previous one using a Likert scale with 5 items:

Compared to the ride before, how did it feel to ride the pedelec this time?

much better	slightly better	no difference	slightly worse	much worse

Results

In order to evaluate the stability of the pedelec with and without the assistance system, the rectified value of the recorded signals were calculated separately for the sections at 5 km/h and at 6.5 km/h.

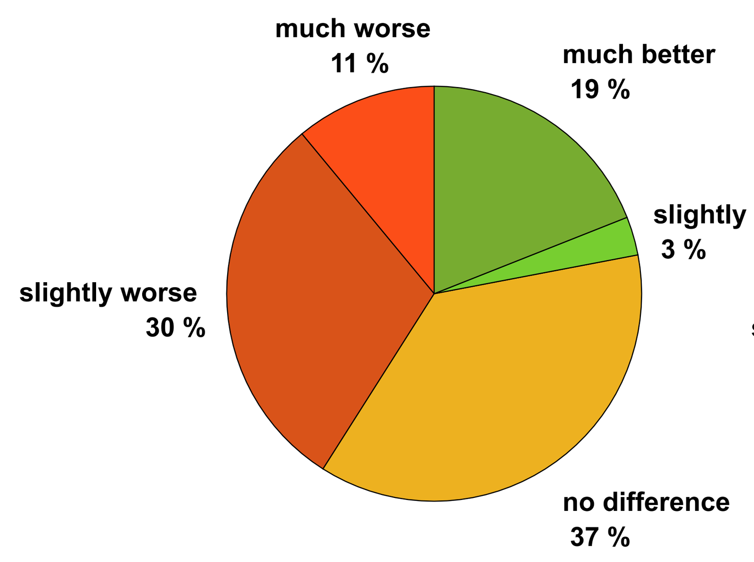
Tab. 1: Means and standarddeviation (SD) of the recorded signals

		C0		C1		C2	
		mean	SD	mean	SD	mean	SD
5 km/h	Roll angle (deg)	0.83	0.18	0.72	0.17	0.70	0.19
	Roll rate (deg/s)	2.19	0.51	1.63	0.33	1.57	0.42
	Steer angle (deg)	6.09	1.19	4.85	0.99	4.80	1.08
	Steer rate (deg/s)	20.11	4.48	15.66	3.89	15.94	4.57
6,5 km/h	Roll angle (deg)	0.83	0.26	0.75	0.22	0.76	0.22
	Roll rate (deg/s)	1.96	0.64	1.39	0.43	1.40	0.37
	Steer angle (deg)	4.44	1.55	3.43	0.96	3.47	0.82
	Steer rate (deg/s)	14.24	4.87	9.64	3.25	9.90	3.11

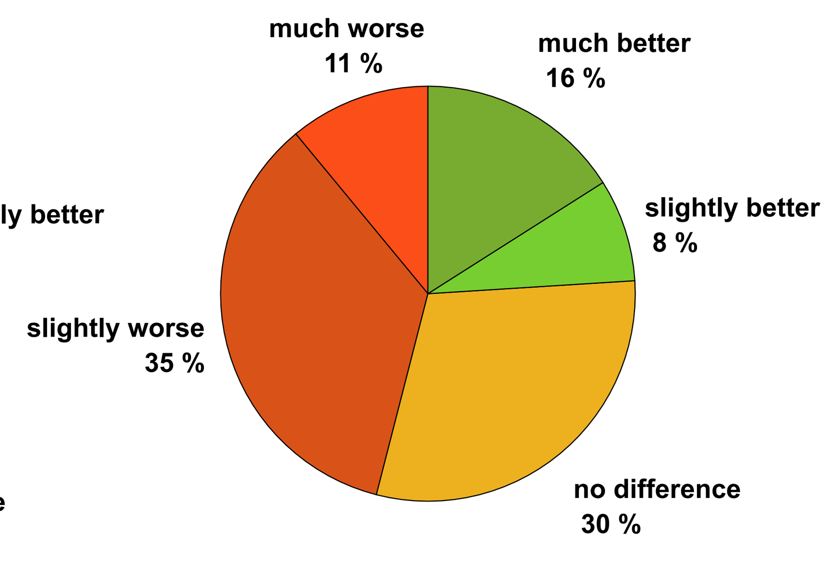
At both 5 km/h and 6.5 km/h, the assistance system was able to significantly **reduce steer and roll movements** and thus **increase stability.**

Although the assistance system objectively improved the stability of the pedelec, less than 25% of the test rides were perceived as better.

C1 compared to C0



C2 compared to C0



Comments of the participants were:

- The steering interventions were perceived as unfamiliar (no familiarization ride was performed with the system).
- They had the impression that the system was taking control of the steering.

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Federal Ministry of Education and Research
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