



Human Factor Affects Eye Movement Pattern during Riding Motorcycle on the Mountain

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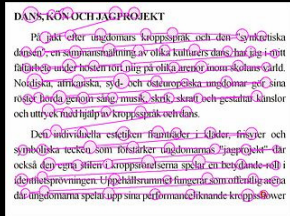
2011.9.18

Outline

- Introduction & Related Work
- Settings
- Methods
- Experiment Results
- Conclusion & Future Work

Introduction & Related Work

- Eye movement pattern in static activities



reading



web



Musical sight reading

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Introduction & Related Work

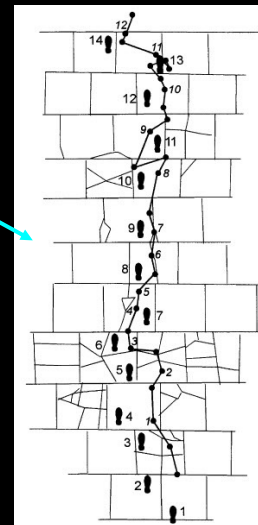
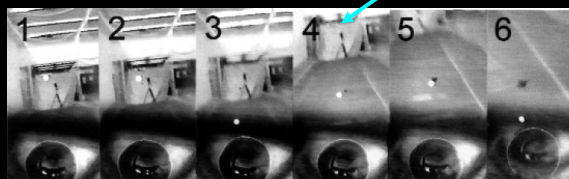
- Eye movement pattern in active tasks



driving car

locomotion

playing baseball



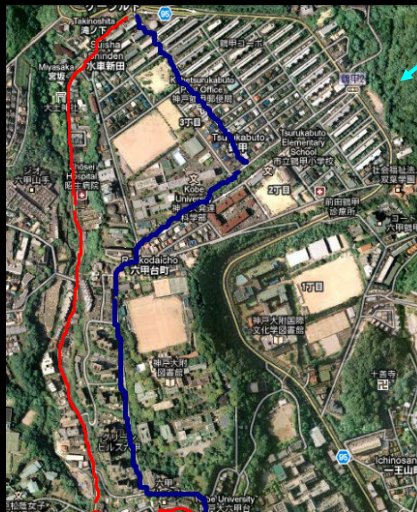
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Introduction & Related Work

- Taking riding bicycle as a specific case
 - Has not been fully considered
 - Unique actions, like checking roadbed
 - Climbing up and down the mountain
- Analyzing how human factor, e.g. artificial environment, influences eye movement pattern

Settings



Rokko Mountain
located in Kobe, Japan

- Circle route
 - Temperature: 8° - 15°
 - 30 minutes
 - 15 km
- 3 healthy subjects
 - 27 ± 2 years old
 - 58.4 ± 7 kg in weight
 - 170 ± 5 cm in height

Settings



- Phase 1: Calibrate camera
- Phase 2: Recording data in SD card
- Phase 3: Analyzing pattern offline

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Methods

- Equipment Calibration
 - Average distance between pupil: 63mm
 - Distance between marks and subject: 2000mm



back view



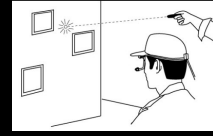
side view

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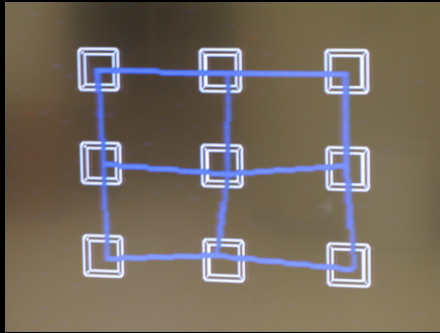
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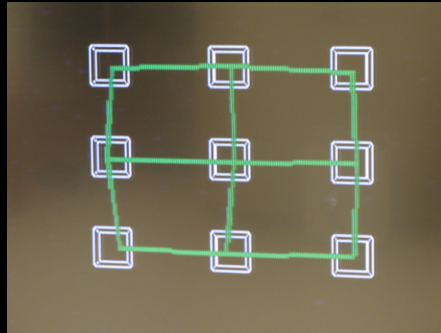
Methods



- Equipment Calibration



left eye



right eye

Methods

- Safety check in Japan traffic

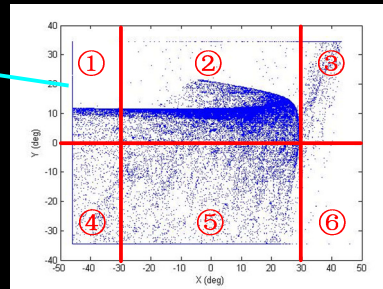


Results

- Eye mark analysis (left eye)

Checking traffic situation,
especially at a traffic corner

need head to rotate for
coordination

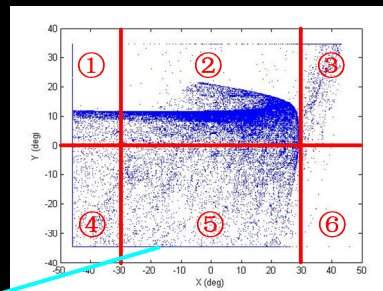


eye mark tracking point cloud

Results

- Eye mark analysis (left eye)

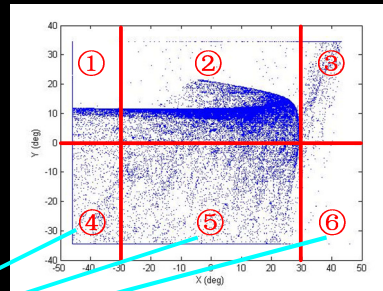
Looking at some particular
places, e.g. speedometer



eye mark tracking point cloud

Results

- Eye mark analysis (left eye)



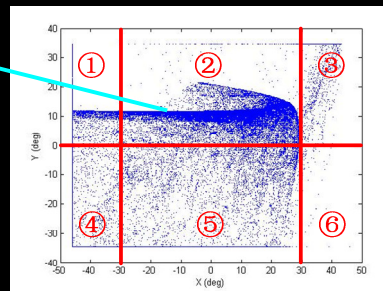
Checking the road in front
of him (or her)

eye mark tracking point cloud

Results

- Eye mark analysis (left eye)

Gazing in the horizon
direction for the most time
(no vehicle coming from the
opposite direction)

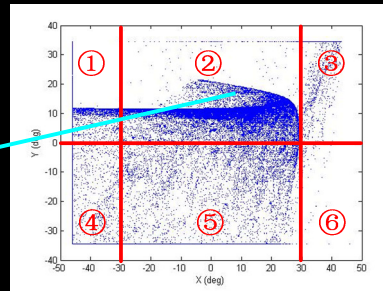


eye mark tracking point cloud

Results

- Eye mark analysis (left eye)

Gazing at vehicle and pedestrian in front of the rider

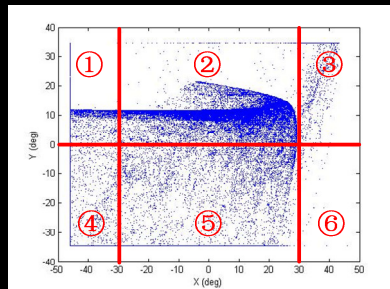


eye mark tracking point cloud

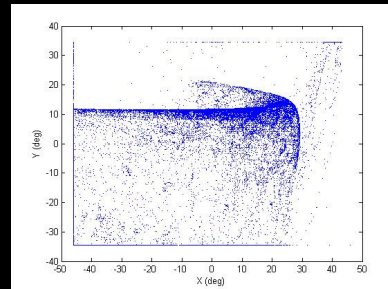
Results

- Eye mark analysis (left eye)

Paying more attention on vehicle from the opposite lane



eye mark tracking point cloud
(riding up the mountain)

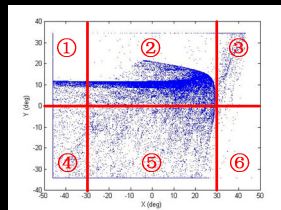


(riding down the mountain)

Results

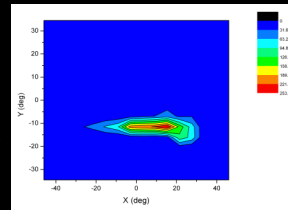
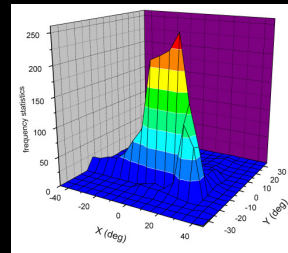
- Fixation point analysis (left eye)

what the eyes always glance at have no direct relation with what eyes fixate on



eye mark tracking point cloud

no relation



fixation frequency distribution

Results

- Fixation occurs during

- waiting for traffic signal;
- stopping because the front vehicle stops;
- observing things close to the rider (e.g. roadbed);
- looking at things on the road side (e.g. building);
- watching vehicle from the opposite lane;
- confirming the destination direction.

Results

- Fixation point analysis (left eye)



Index	Fix. No.	Start (HMS)	Duration (sec)	Fixation place	Occasion
Left eye	L207	00:02:31.403	1.201	building beside the traffic light	a)
	L322	00:03:25.641	2.753	license plate of the vehicle in front of it	b)
	L905	00:07:55.363	0.968	trees beside the road	d)
	L1312	00:11:13.296	0.984	traffic line in front of it	d)
	L1395	00:11:49.616	1.018	tailstock of the vehicle in front of it	b)

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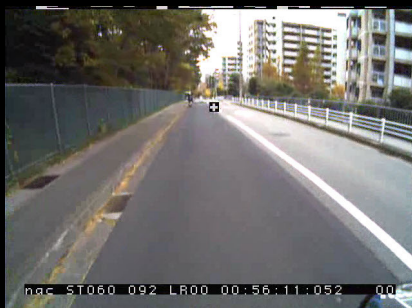
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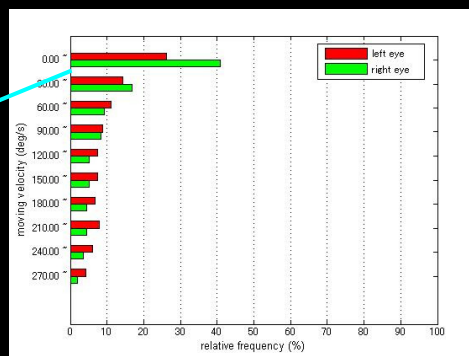


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Results

- Eye moving velocity statistics

slow motion is the ordinary state when changing fixation point

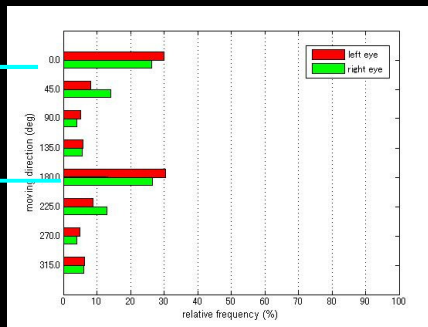


Results

- Eye moving direction statistics

eyes keep relative still

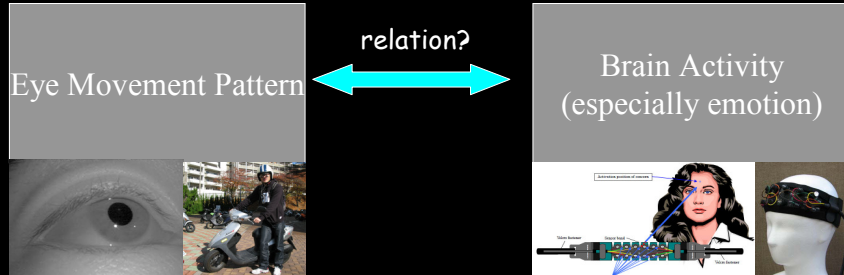
eyes check traffic condition
(from left to right quickly)



Conclusion & Future Work

- The contribution
 - considering the eye movement pattern in the situation of riding bicycle on the mountain;
 - giving the evidence how the human factors affect the eye mark tracking trajectory and fixation point movement;

Conclusion & Future Work



Subject is equipped with removable eye and brain measuring equipment.

