

Video Validation of a Maneuver Classification Algorithm for Naturalistic Driving Data

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- **Distributions**

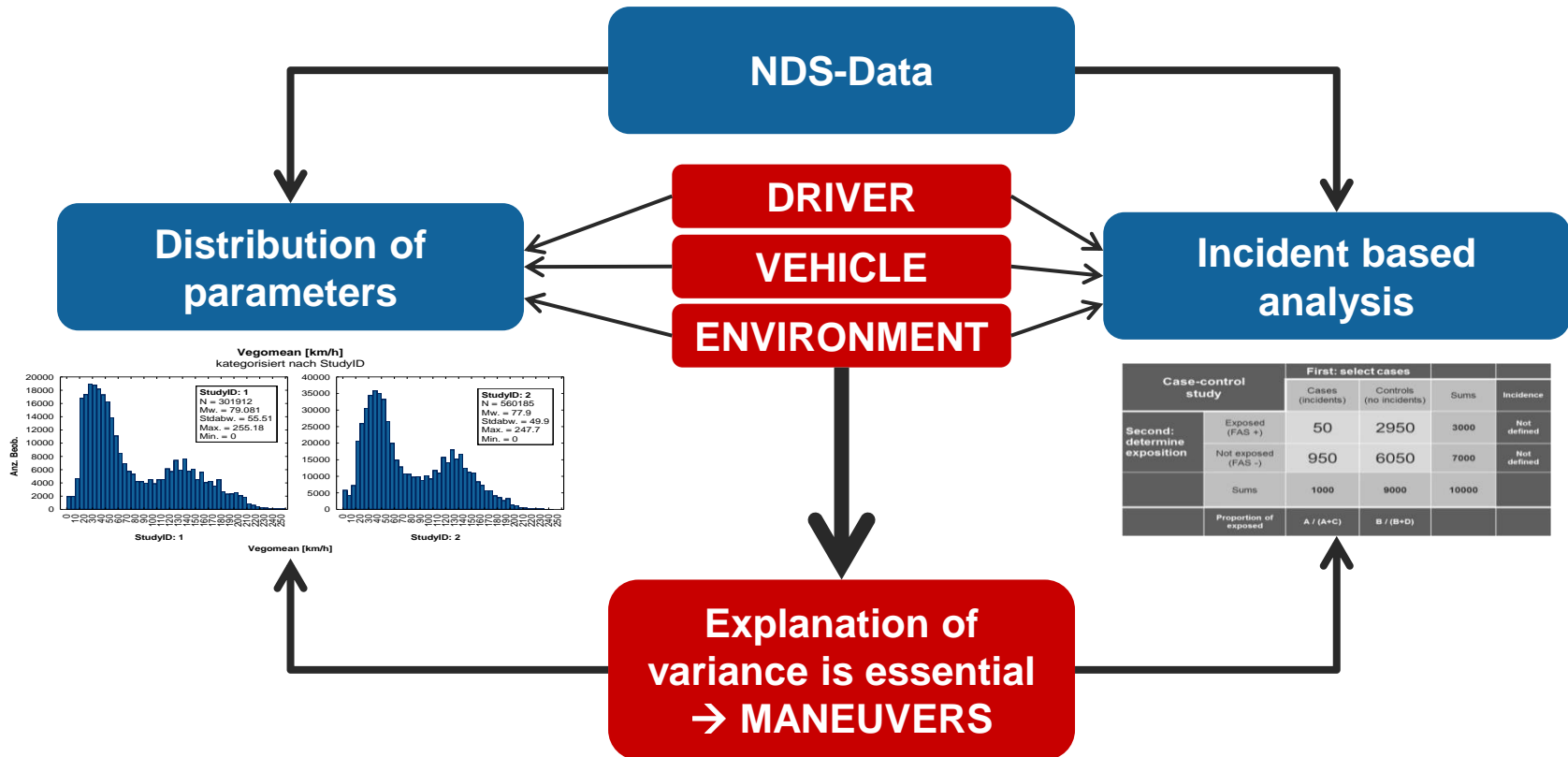
- What is the desired speed at motorway / rural road / city?
- How long are lane changes?
- Change of the mean Time-Headway (THW) during phoning / bad weather / etc. ?

- **Frequencies (exposition)**

- How many lane changes are made per hour at the motorway?
- How often occurs phoning?
- How often occur critical events ? → RISK

- **Risk**

- Is phoning increasing the risk for „critical approaching“ incidents?



AIM:

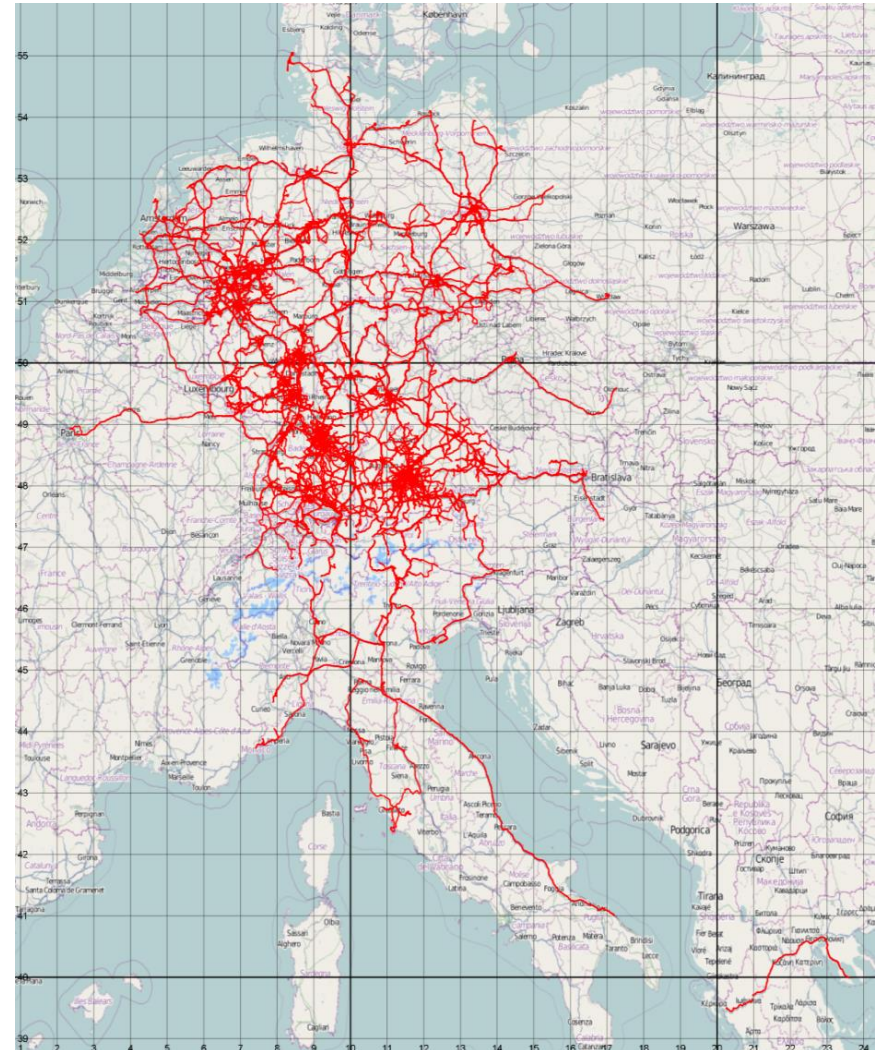
- Development of an automatized algorithm for the classification of driving maneuvers.
- Uninterrupted description of a trip.

PROCEDURE:

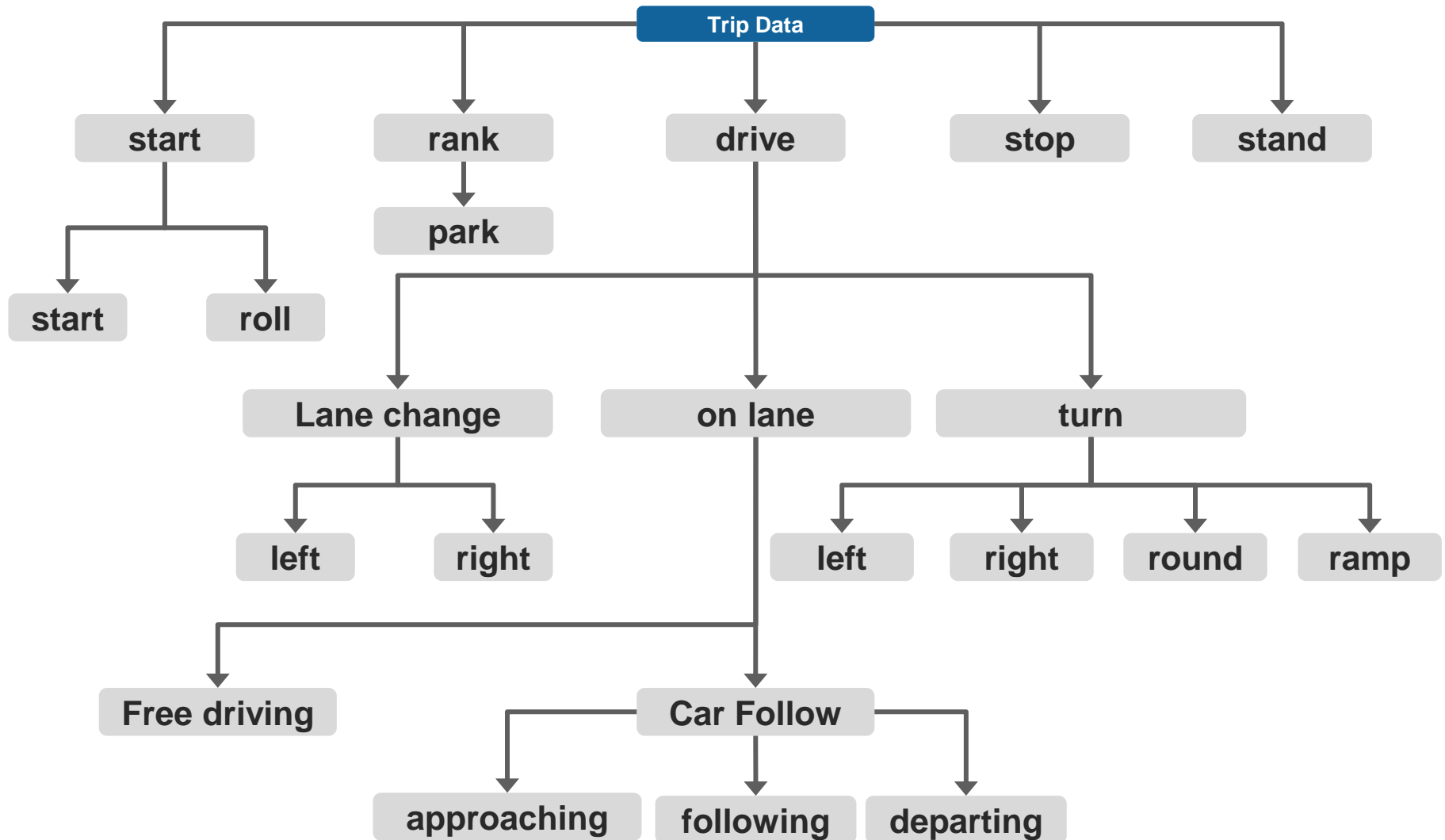
- exact definition of the maneuvers
- Development of algorithms based on randomly selected video-coded trips
 - Check of the available signals
 - Correction of biased signals
 - Definition of criteria for the maneuver classification
- Assessment of the algorithms by comparison of video-coding and algorithm-classification.

Results after preprocessing steps:

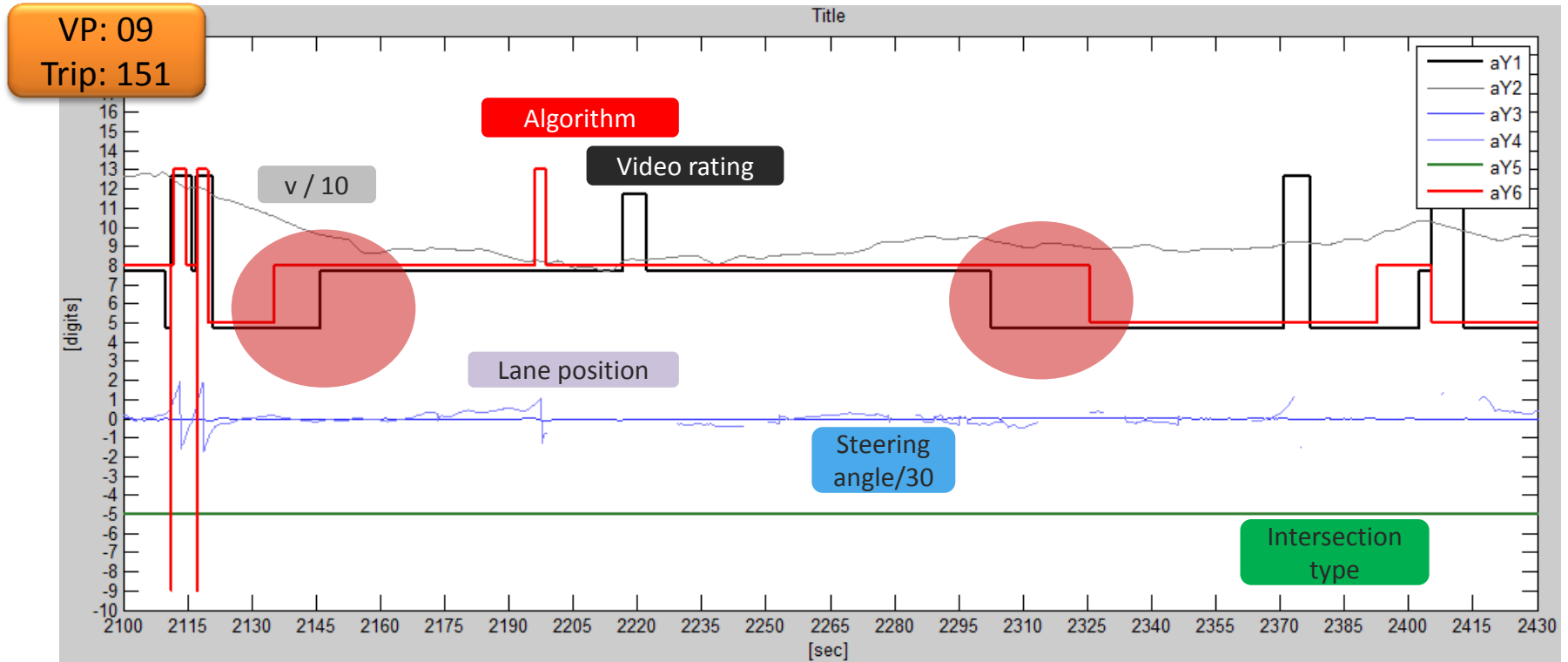
	Overall
Number of Participants	115
Number of Participants with complete data set	104
Number of Trips	39 703
Observed Kilometers	1 013 262
Observed Hours	15 129



Hierarchy of defined maneuvers



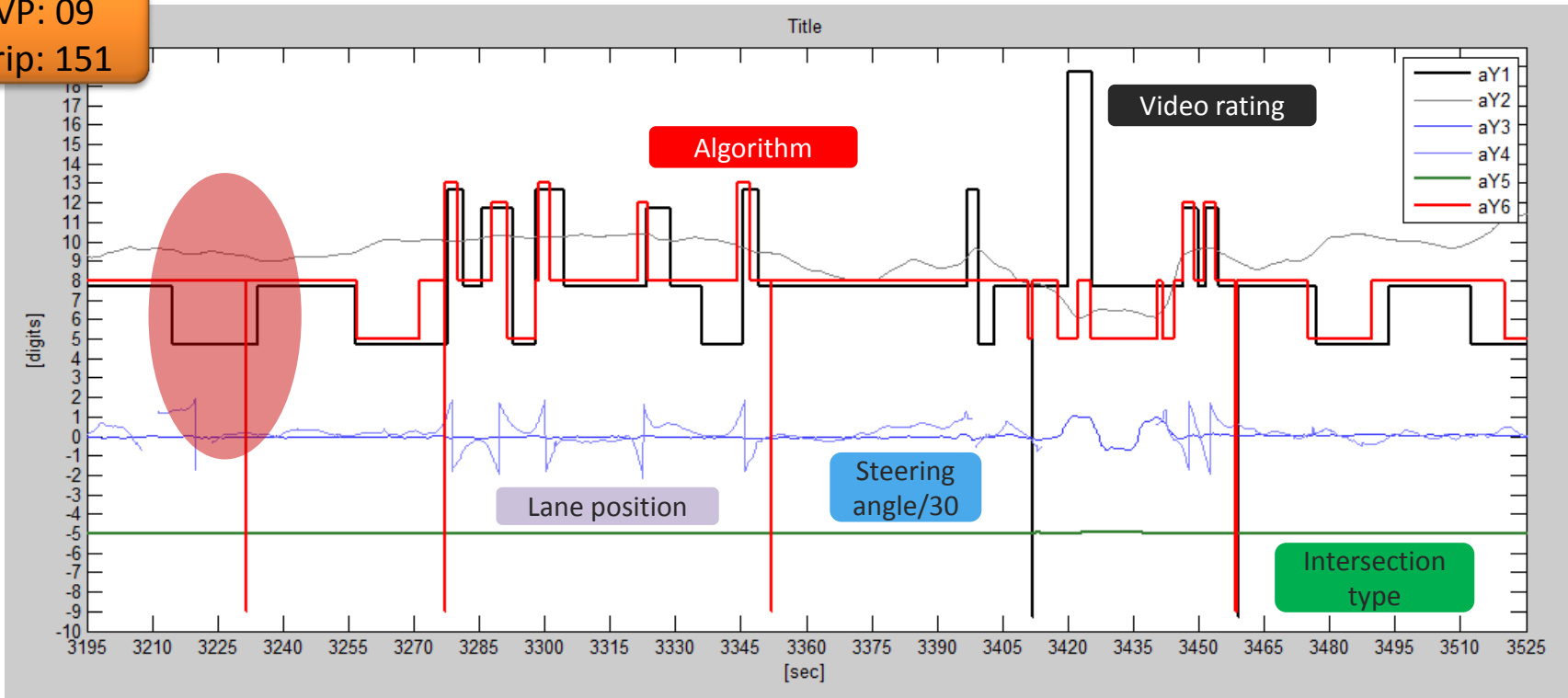
Free Drive vs. Car-Follow I



- Car-Follow is (particularly at high speeds) detected EARLIER and LONGER then by video rating
- CONSEQUENCE: less overlap

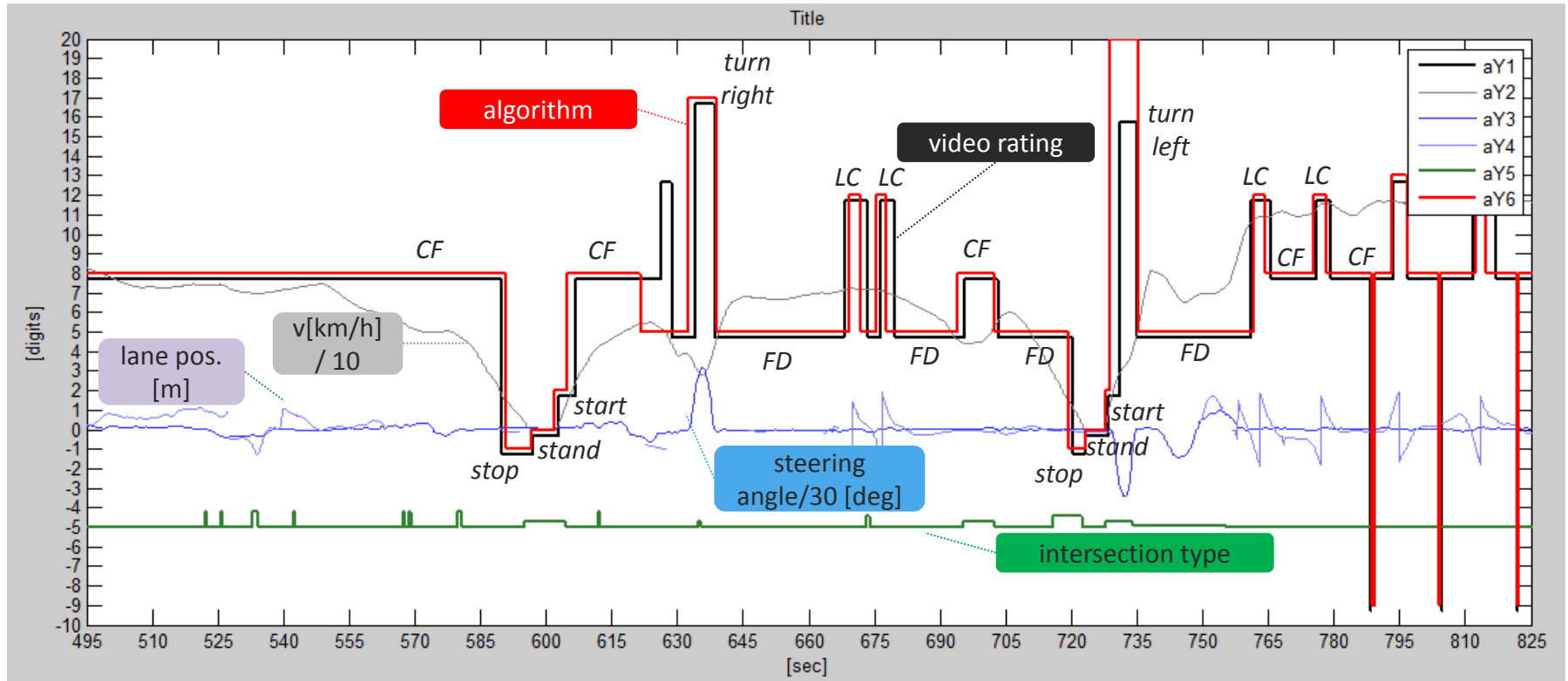
Free Drive vs. Car-Follow II

VP: 09
Trip: 151



- A continuous Car-Follow maneuver in the algorithm is sometimes divided by „Free Drive“ in video rating because of high speed → high object distance → not visible on video
- CONSEQUENCE: missing „Free-Drive“ in algorithm

Example – Section of a trip



Coding of 12 randomly selected longer trips for evaluating algorithm for maneuver detection.

TripIDALL	exact match per data point [%]
1009037	81.09%
1009151	80.71%
1009196	82.58%
1014046	90.08%
1014141	89.59%
1014262	86.75%
1021062	77.04%
1021144	86.50%
1021186	82.45%
1024064	83.65%
1024173	86.58%
1024304	85.02%



- 77% - 90% exact match of all maneuvers

Number of classified maneuvers

maneuver	n	percent	maneuver	n	percent
motor off	29531	0.96%	car-follow	836363	27.17%
stop	146960	4.77%	lane change left	139562	4.53%
stand	235342	7.65%	lane change right	159540	5.18%
roll	51094	1.66%	turn left	144725	4.70%
start	139066	4.52%	turn right	140453	4.56%
rank	68822	2.24%	roundabout	21935	0.71%
park	18562	0.60%	ramp	17887	0.58%
free-drive	916049	29.76%	turn undefined	12223	0.40%
			missing	0	0.00%
			total	3078114	100.00%

Algorithm vs. Rating

algorithm → video coding					video coding → algorithm				
maneuver	n	% correct	most common mismatch maneuver	% (mismatch)	n	% correct	most common mismatch maneuver	% (mismatch)	
stop	48	72.9%	rank & park	19%	57	66.7%	free & follow	23%	
stand	77	94.8%	free	3%	86	76.7%	turn left	6%	
stop&go	12	50.0%	stand	50%	9	55.6%	stop & star t& rank	33%	
start	37	67.6%	stand	24%	49	36.7%	free & follow & turn left	47%	
ranking	18	66.7%	stand & stop/go & start	22%	14	64.3%	stop	14%	
parking	9	100.0%		0%	13	69.2%	turn right	15%	
free	672	80.5%	follow	9%	640	77.2%	follow	17%	
follow	673	68.2%	free	23%	573	94.2%	free	3%	
LC left	167	89.8%	free & follow	10%	245	49.8%	free & follow	49%	
LC right	191	95.3%	free & follow	5%	238	66.4%	free & follow	33%	
turn left	45	55.6%	free & stand	42%	55	58.2%	rank & park & turn invalid	27%	
turn right	47	53.2%	free & stand	26%	52	59.6%	free	25%	
roundabout	13	92.3%	turn right	8%	19	57.9%	free & ramp	32%	
ramp	27	66.7%	turn & round	19%	38	18.4%	free & follow	82%	
sum	2036				2088				

- Stop → ranking, parking / Roll → stand (overlap...)
- Start → stand (overlap...) / rank → stand, roll, start
- Follow → free / free → follow
- Turning → free (major road bending, ramp)

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- **Development of an automatized algorithm for the classification of driving maneuvers.**
- **Using video coded trips for developing and evaluating algorithms for maneuver classification.**
- **A high detection rate for different maneuvers was achieved.**
- **Structure of classification allows to detect more complex maneuvers (for example overtaking).**
- **Maneuvers build a base for a better analysis of ND-data, for example distracted driving.**

Thank you!

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