NDRS2018

Risk situation prediction with Near-miss incident data base

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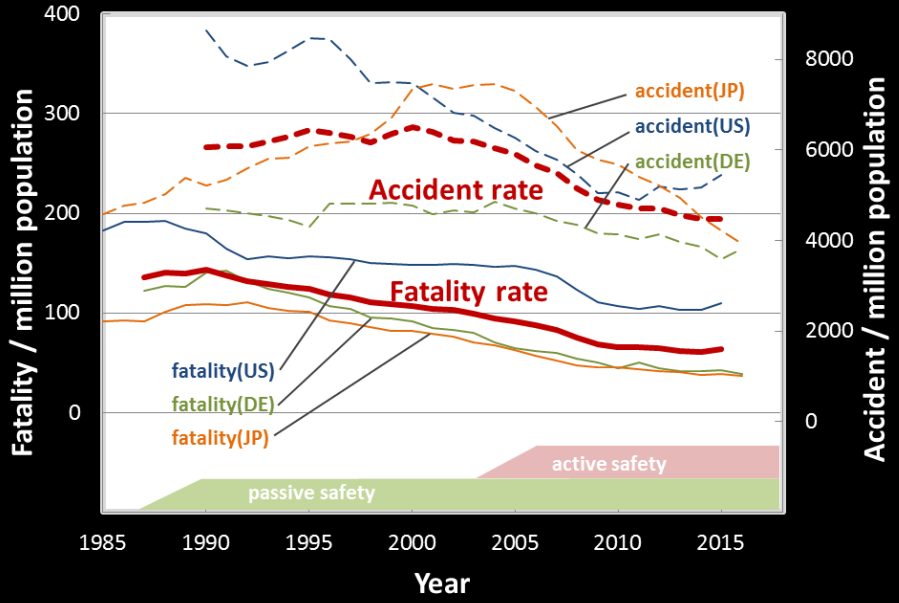
Background



[1] OECD data, https://data.oecd.org/transport/road-accidents.htm /
[2] International Road Federation, "World Road Statistics (2010)"
[3] ITARDA, "Traffic statistics (2010)" (Japanese)
[4] IRTAD, "Annual Report (2014)"

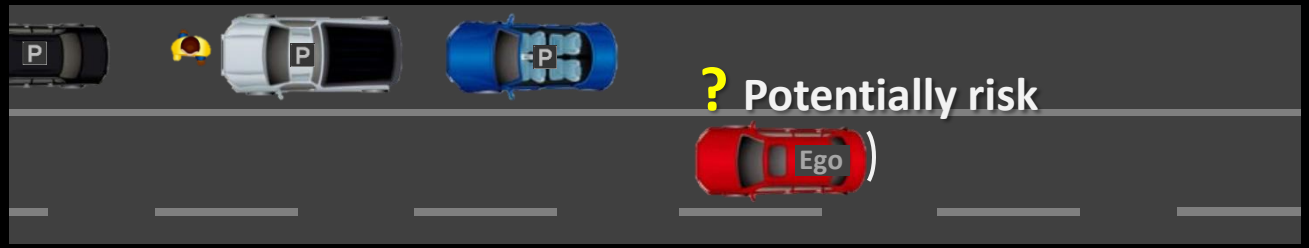
ADAS (Advanced Driver Assistance System) greatly contributes to the reduction

But in the last 5 years, it has been flat

Background

Functional limit of conventional ADAS in unexpectable situation

Example of potential risk predictable ADAS



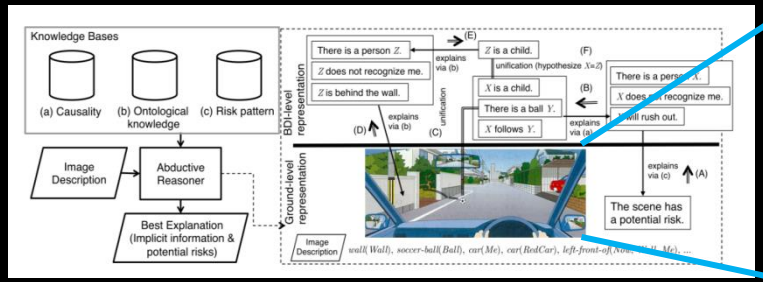
Motivation : Create potential risk predictable ADAS

Background

Prior art

Expert system

Inoue, Context-aware logical abduction-based risk prediction[5]



Advantage:

Driver can understand situation easily

Disadvantage:

Limit of human knowledge and experience

[5] N. Inoue, Y. Kuriya, S. Kobayashi, K. Inoue “Recognizing Potential Traffic Risks through Logic-based Deep Scene Understanding,” in 22nd ITS World Congress, 2015

Our approach

Create prediction model using incident DB & machine leaning

Target prediction time : 3 sec ahead

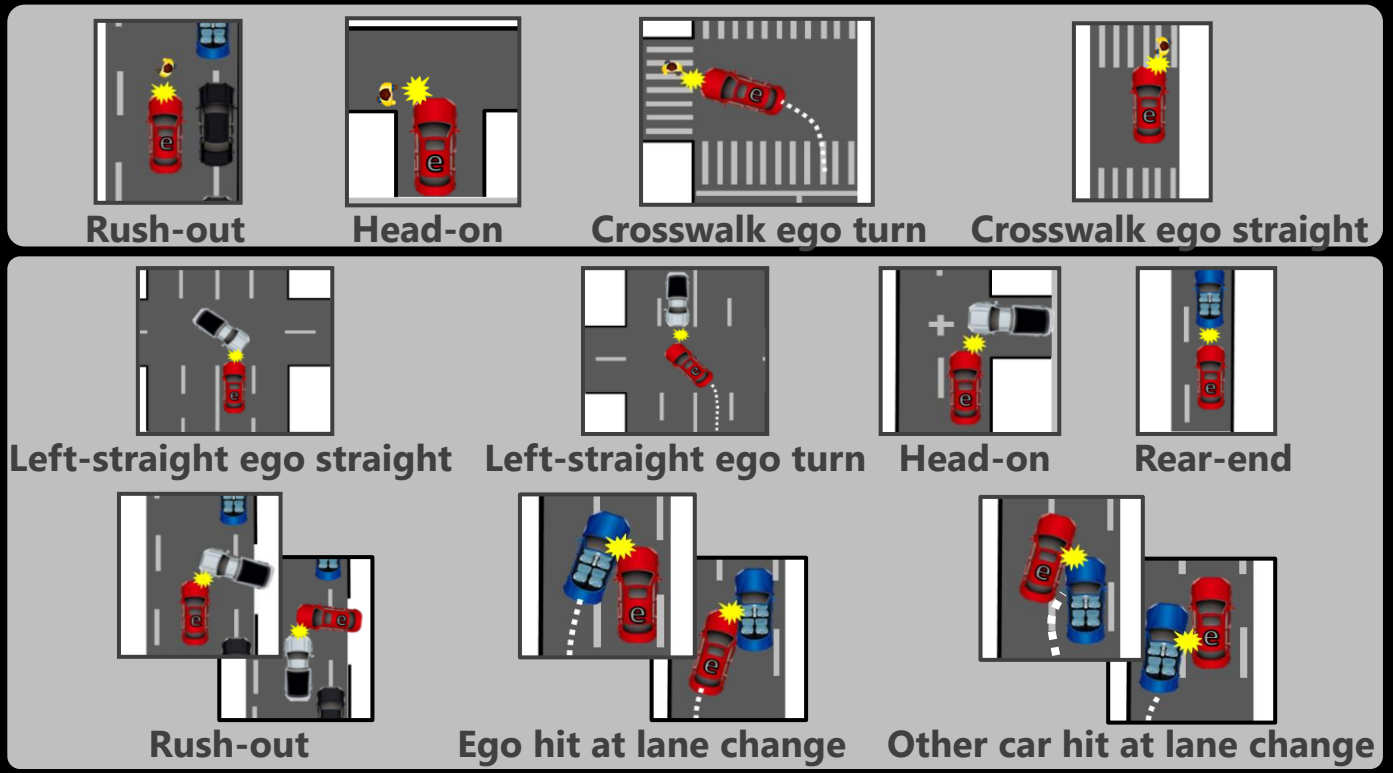
Feature value dataset

ego speed, brake state, …
weather, intersection type, …
Pedestrian behaviour, other car behaviour, …
distance to intersection, …

Risk situation

Our approach

11 risk situation



TUAT Near-miss incident DB

Constructed by TUAT (Tokyo Univ. A&T Smart Mobility research center)

More than 110,000 of crash/near-crash data collected from device on taxi

Front view video

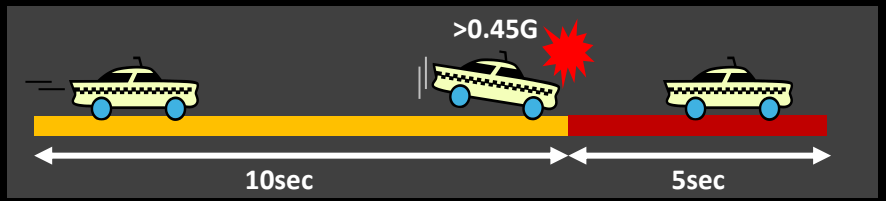
Ego vehicle state

speed / brake / blinker / G / global position

Road features

road type / intersection type / behavior …

Incident types (we used them as risk situation)



Use stored traffic / ego state features and annotate features from video

Risk situation prediction

Features values for each incident cases → 99 feature values

Random data samples for each risk situation type → 3949 samples

99 feature values

Risk situation

3949 samples

caseId	straightRoad	intersec	curve	priority	trafficLight	crossWalk	stopLine	trafficSign				brake1	brake2	brake3	brake4	blink1	blink2	blink3	blink4	Cat
95277	biDirectWay	T	straight	priority	trafficLight	crossWalk	stopLine	fewTrafficSign	...	...	...	ON	ON	ON	ON	R	OFF	OFF	OFF	V_CutInToOther
276772	biDirectWay	_4	straight	noPriority	trafficLight	crossWalk	stopLine	normalTrafficSign	...	...	...	OFF	ON	OFF	OFF	R	R	OFF	OFF	V_CutInToOther
179268	biDirectWay	T	straight	noPriority	trafficLight	crossWalk	stopLine	fewTrafficSign	...	...	...	OFF	OFF	OFF	OFF	R	R	R	R	V_CutInToOther
254833	biDirectWay	Non	straight	noPriority	trafficLight	crossWalk	stopLine	manyTrafficSign	...	...	...	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	V_CutInToOther
251007	biDirectWay	T	straight	noPriority	noTrafficLight	crossWalk	stopLine	fewTrafficSign	...	...	...	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	V_CutInToOther
312037	biDirectWay	Non	straight	noPriority	trafficLight	crossWalk	stopLine	fewTrafficSign	...	...	...	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	V_CutInToOther
154988	biDirectWay	_4	straight	noPriority	trafficLight	crossWalk	stopLine	fewTrafficSign	...	...	...	OFF	OFF	OFF	OFF	R	OFF	OFF	OFF	V_CutInToOther
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
120685	other	Y	straight	priority	noTrafficLight	crossWalk	stopLine	fewTrafficSign	...	...	...	ON	ON	OFF	OFF	L	L	L	OFF	V_HeadOn
279240	biDirectWay	_4	straight	noPriority	noTrafficLight	noCrossWalk	stopLine	normalTrafficSign	...	...	...	ON	ON	OFF	OFF	L	L	L	OFF	V_HeadOn
73304	biDirectWay	T	obtuse	priority	trafficLight	crossWalk	stopLine	fewTrafficSign	...	...	...	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	V_HeadOn
118265	other	_5	straight	priority	trafficLight	crossWalk	stopLine	fewTrafficSign	...	...	...	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	V_HeadOn
73483	biDirectWay	T	straight	noPriority	noTrafficLight	crossWalk	stopLine	fewTrafficSign	...	...	...	OFF	ON	ON	ON	L	L	L	OFF	V_HeadOn
261469	biDirectWay	T	straight	noPriority	noTrafficLight	noCrossWalk	stopLine	fewTrafficSign	...	...	...	ON	ON	OFF	OFF	L	L	OFF	OFF	V_HeadOn
329869	other	_4	straight	noPriority	noTrafficLight	noCrossWalk	noStopLine	fewTrafficSign	...	...	...	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	V_HeadOn

Use those data for machine learning for risk situation prediction model

Prediction performance evaluation

Compare 4 classifiers :

Logistic regression / Ridge classifier / Random Forest / Multi Layer Perceptron

Evaluate with 20 fields cross-validation

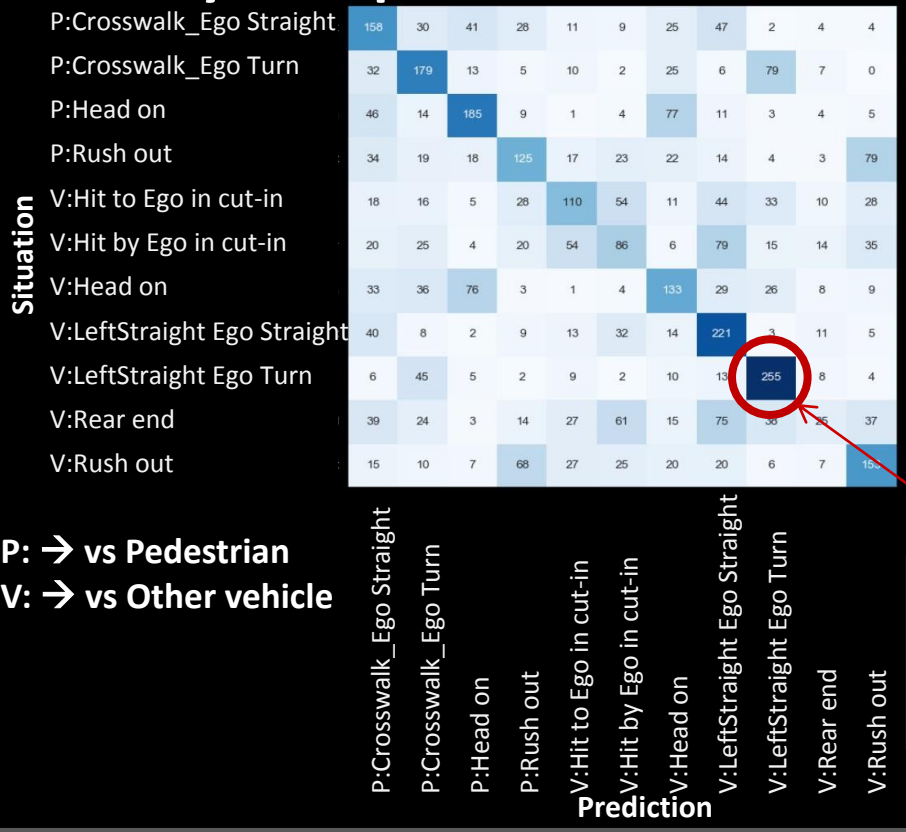
Learning classifier type		Prediction score (recall)		Overfitting rate
		Test sample	Training sample	(train-test)/test
Human subject (base line)		0.37	--------	--------
Classifier	Logistic Regression (LR)	0.43	0.49	0.13
	Ridge Classifier (RC)	0.43	0.49	0.14
	Random Forest (RF)	0.39	0.41	0.07
	Multi Layer Perceptron (MLP)	0.41	0.45	0.09

Our system prediction score is slightly better than base line

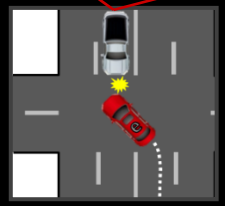
RF and MLP perform better performance

Prediction performance analysis

Our system prediction score



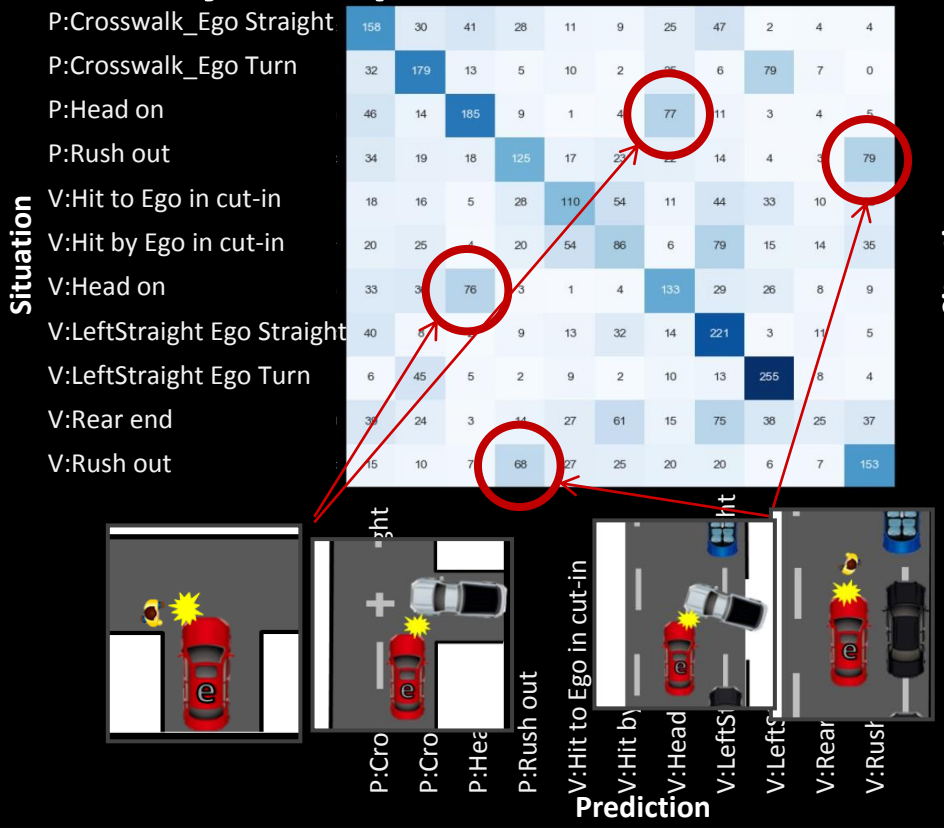
P: → vs Pedestrian
V: → vs Other vehicle



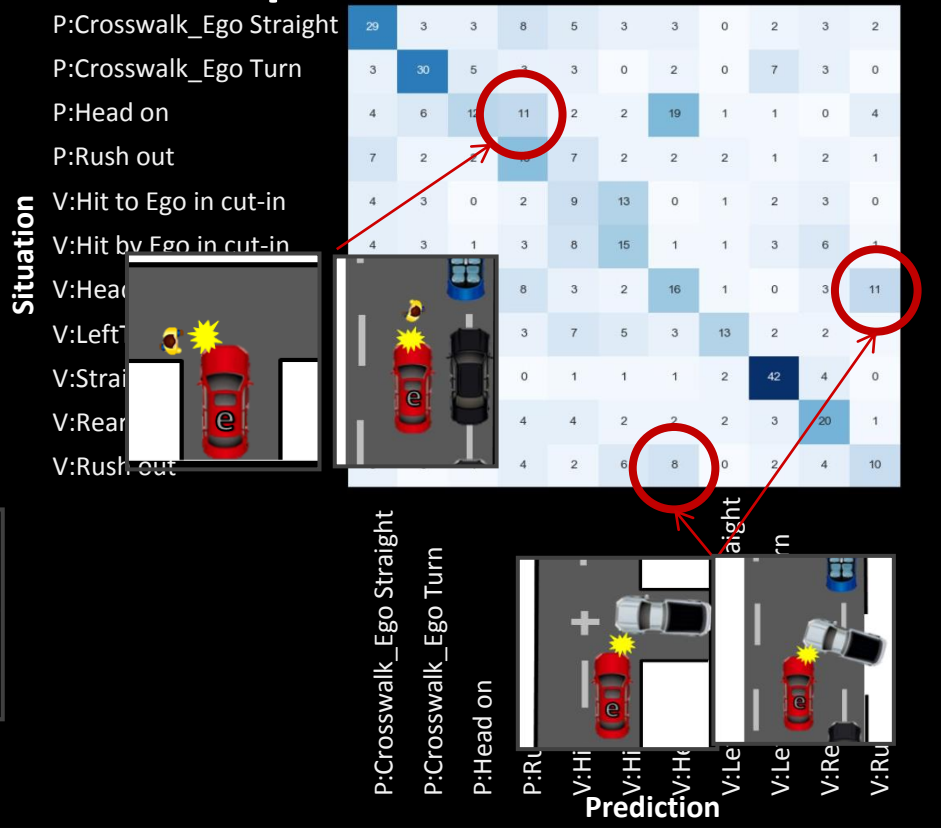
Human prediction score

Prediction performance analysis

Our system prediction score



Human prediction score



Application to ADAS

System implement on car

Test result on real road

Summary

proposed completely data driven Potential risk situation prediction

evaluated prediction performance

showed an ADAS application

Next plan:

- extend data base to wider area
- evaluate driver feeling

Thank you for your attention