Part 4: Fusion Infrastructures and Vehicle On-board assistance to safe driving and to driving risk prevention

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On-board assistance to safe driving and to driving risk prevention

> Key Notion : risk that the diver takes

~~**Risk= Probability**~~

Risk a priori ?
Risk a posteriori ?

https://www.youtube.com/watch?v=24nCV5zWcws

> Key Notion : The « **near miss** »
> Theory : **Triangle of Risk** (Frank E. Bird)

~~**Observe accidents**~~

> Key Notion : **Rules** for anticipation and **prevention** of risk



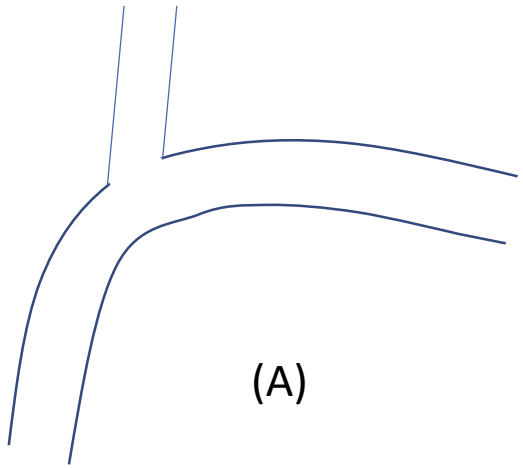
75% of driving risk comes from a driving behaviour that is not adapted to the local complexity of infrastructure

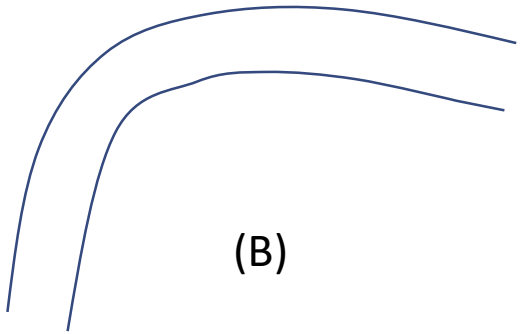
Prevention of risk cannot be done by « accurate detection and good reflexes » (ex : emergency braking)

Reasearchers and experts of road infrastructure have a validated knowkedge on road safety and driving risk assessment

Example of knowledge about driving risk by the infrastructures experts

> Example of knowledge (source : public report SETRA on driving risk)





« Driving risk on infrastructure (A) is twice the driving risk on infrastructure (B) »

What NEXYAD have done :

. Pattern Recognition of key infrastructure configurations: pattern on the **navigation map**.
Note : You can often move from one pattern to another gradually and continuously.
> Deep Learning on the HERE map (200 countries)

. Extraction of "risk" expertise (more than 5000 rules)

. Real time execution 20 times per second in an embedded AI : **SafetyNex**

How to build the rules of cautious/prevention ?

- To behave well in a situation of risk one must have identified the situation (seen, recognized, read, understood):

  . Slowing down can increase the exposure time of the situation to the driver's brain or to the system of artificial understanding. Adapting its speed to the complexity of the situation is therefore a good way to control the risk. We find a rule of the highway code!

- In order to be able to act on the vehicle correctly, it must be “enough controllable" (observability and commandability theory)

  . Speed decreases controllability, especially the ability of the vehicle to turn and stop - adjusting its speed to the potential for future control is a good track.

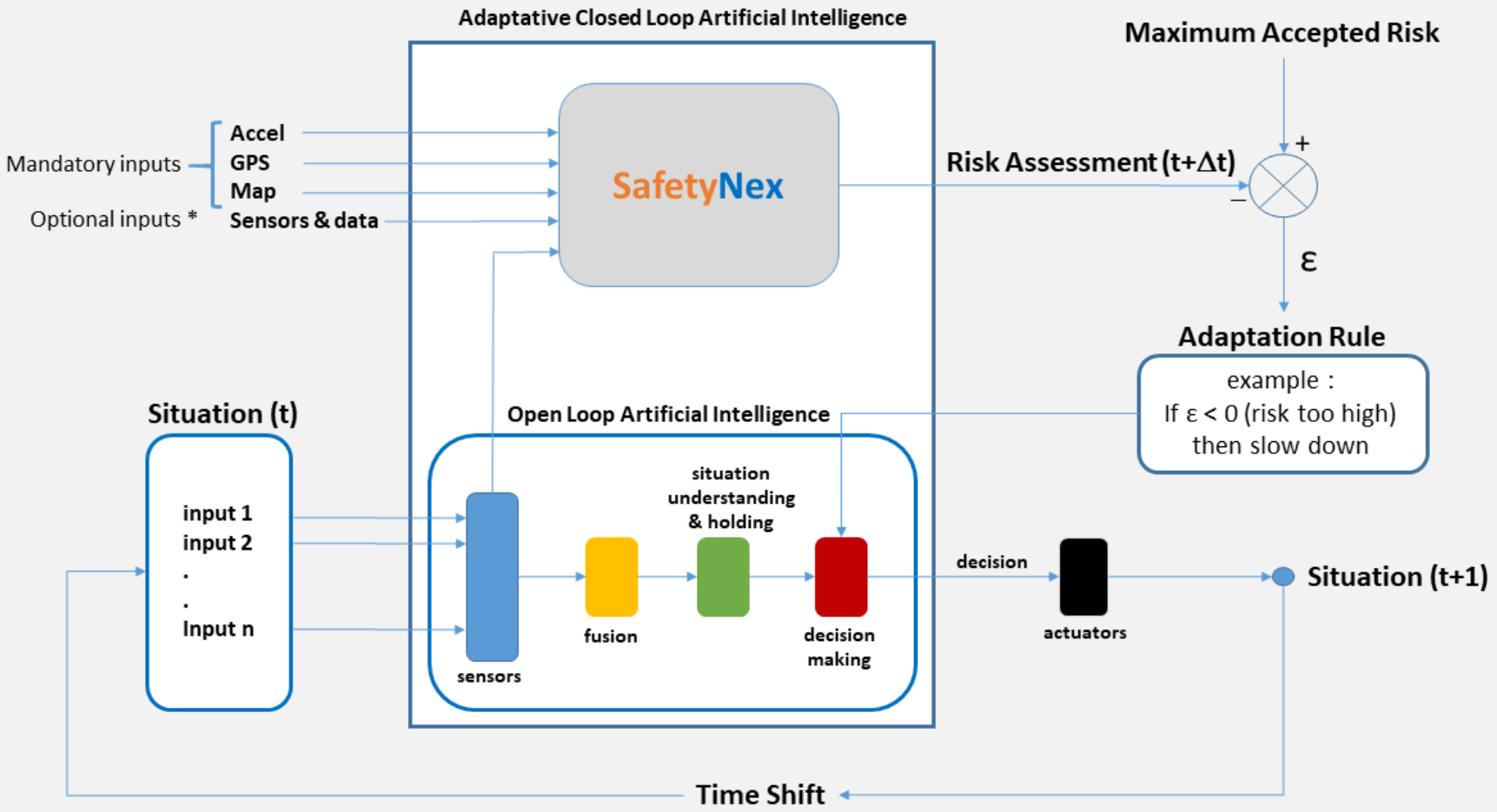
What NEXYAD have done :

. Real-time computing of the risk taken by driver (20 times per second)
Risk = degree of inadequacy of the current or predicted speed to the local complexity of the infrastructure

. Detailed validation on 50 million km

. Use by the test panel during 2 years (3,500 testers): 100 million km

Figure of risk control for an Autonomous Vehicle



* *Optional inputs : car interdistance, visibility, time to collision, size of free space, presence of vulnerables, road grip, weather, traffic, road works, accidents, etc.*

<u>Effect of explicit use of driving risk notion :</u>

. Adaptability of AD to situations never imagined during its design (closed loop effect).

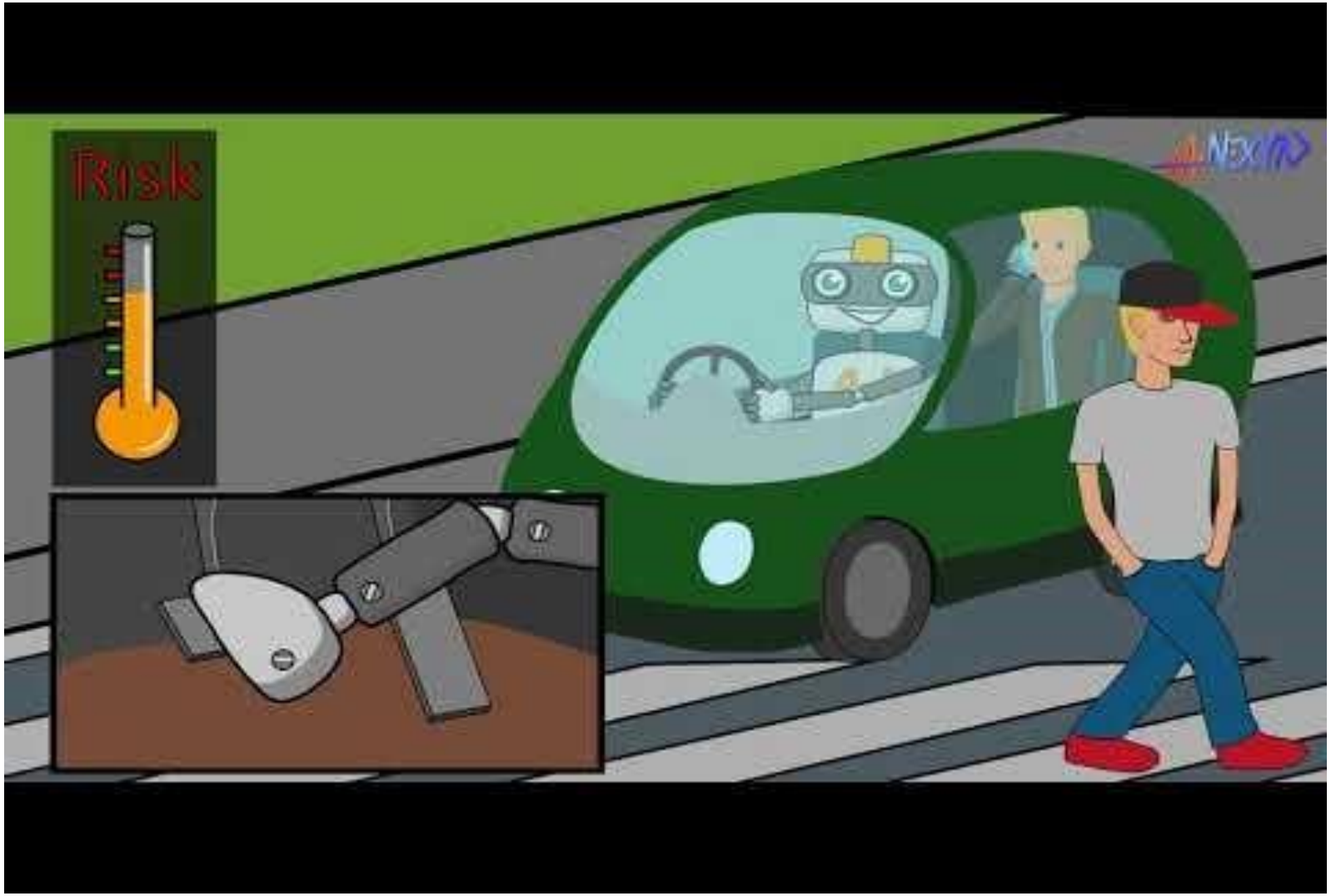
. Easy to modulate the level of aggressiveness of the HAV by modifying only the value of the maximum accepted risk.

SafetyNex additional inputs

- SafetyNex in basic version (basic entries = digital map of navigation, GPS, accelerator) deals "only" 75% of the risk (in very low cost)
- To process the remaining 25%, NEXYAD adds additional inputs (optional)
  - Information about other mobiles: time to collision, distance, size of free space, number of vulnerable, ... 15% of the risk
  - Information on the weather conditions: atmospheric visibility, mobilizable adhesion, ... 8% of the risk
- NB: the state of alertness or drowsiness of the driver is NOT a driving behavior, it is a non-functional physiological behavior (in the sense of ethology) that allows to predict a future misbehaving behavior. It is therefore not absolutely necessary, but nevertheless useful to further increase the safetyNex anticipation time.

. **75%** of the risk is due to inappropriate driving behavior to the local complexity of the infrastructure, and only NEXYAD has solved this.
. **15%** of the risk is due to inappropriate driving behavior and the presence and trajectory of other detected road users, and 100% of the automotive world is working on this subject.
. **8%** of the risk is due to driving behavior that is unsuitable for visibility or grip. Who is working on it?

Illustration Video



https://www.youtube.com/watch?v=fA8XehYhEM0

. Under deployment for new cars and aftermarket :

. Insurance and fleets: integration by a British OEM of telematics

. ADAS and Vocal Driving Assistants : integration by a Japanese firm of automotive electronics

. Autonomous Vehicle: integration in progress in several autonomous vehicles including the autonomous POD MILLA of the french start-up ISFM