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Autonomous Driving, Tohoku University Sendai - Review of the Excursion 17.07.2017

(Report about my assigned site visit during the Japan Excursion - TU Vienna 2017)

The Excursion to the Tohoku University in Sendai (directly in the ITS Center) was focused on "autonomous driving" and divided into two main sections:

Fig 1 - Students in the class at the ITS Center

1.) A lecture on regional innovation by advanced Mobility System Research and Development

2.) A lecture on Traffic Congestion and Tsunami and its recent Research Activities followed by a live demonstration of electrically operated buses, cars and vehicles as well as the demonstration of an autonomous test car.

We have been one of the first visitors to this ITS Center, it was opened in April 2017 (Fig 1).

The most important findings are summarized below.

1.) Traffic Congestion and Tsunami

On March 11, 2011, a strong 9-year earthquake took place for 3 minutes in the Inshionmaki area. Many people died, even since a Tsunami hit the coast, 30 minutes later. Many people were caught in their car and hit by the tsunami. The inhabitants wanted to escape because they knew that a Tsunami could come. At the same time, they collected their friends / families. There was a high increase in traffic after the earthquake. This led to a congestion, a kind of death trap.

The university has analysed the traffic flows before, during and after the Tsunami. And many studies were made. The basis for this were many sensor data and data from the mobile radio networks. Thus, with Time / Space

Diagrams, the traffic situation can be described.

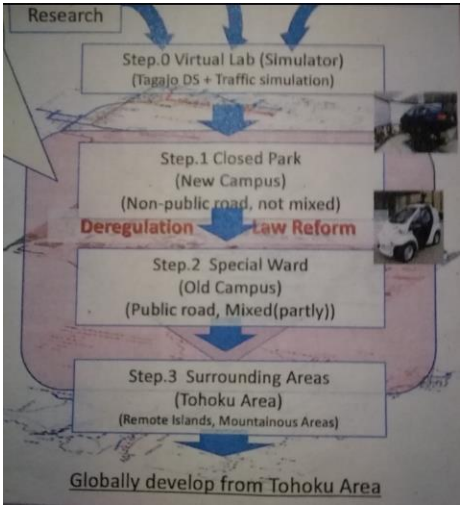

Fig 2 - Advanced Mobility System Practise Field Plan

Based on this, the following steps were carried out:

1. Part of Research

Creation of a geographical model of the region with historical data (transport, routes, population, etc.)

2. Design evaluation

Making a design evaluation by analysing the following questions:

- How did the inhabitants behave after the earthquake?
- What were the ideal and planned evacuation routes?
- Where was the protection and where did they sought it?
- What about the actually needed times for the evacuation?

3. Improvement and restoration of the evacuation plans

On the basis of these questions, several scenarios were created and simulated. Based on the this, first best benchmark analysis are designed. This gives information about good and bad evaluation strategies, Fig. 4.

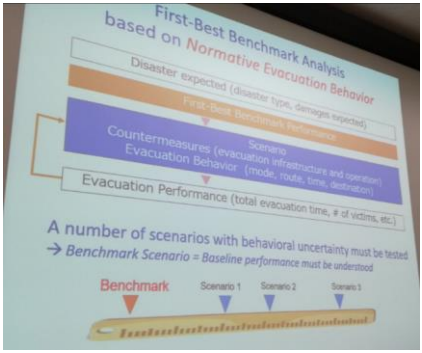

Fig 4 - Sequence of a First-Best Benchmak Anlayse

Summary

The investigation has optimized the (old) evacuation plans. The results indicate, the first best strategy is obtained by solving in time dependent fasion. Several extensions of the model to various local needs are formulated during this investigation.

The presented method was applied to Ishinomaki city with approximately 5.000 links and 100 shelters to confirm the computational feasibility in a mid-sized network. With the knowledge of such benchmark analysis, a further evacuation plan (in future) is more efficient, hopefully they will never be needed.

2. Regional Innovation by Adcanced Mobility System Research and Development and Life Demonstration of electrically operated buses, cars and vehicles as well as the demonstration of an autonomous test car.

There was a theoretical introduction about the ITS Center. 20 research projects are currently being carried out. The focus is on "next generation mobility system". For this purpose, a special ITS area has been set up in this new campus. The budget for the next few years amounts to € 20 million. 300 researchers and employees work here, next to the students.

In a next step, the students got a broad overview of the new research areas.

In the area of highway asset management, for example, a drone was introduced, which inspects bridges. Here will be no complex and dangerous on-site working necessary. The video of the drone, is judged by an expert.

Another focus is sensor fusion. Meanwhile, there are a variety of different sensors (weather, vehicle number, traffic jam, etc.). Each sensor has its advantages and disadvantages. Sensor fusion combines the different sensors and gets the best out, see also Fig. 5.

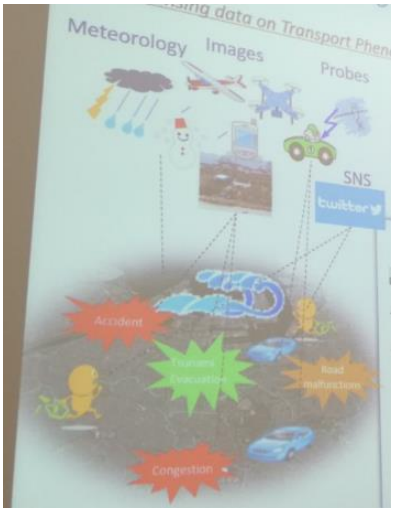

Fig. 5 - Possibilities of further inputs in the context of sensor fusion

A problem often associated with electric cars in the EU is the question, where the whole electric current comes from? In Japan, they are having enough electricity reserves. A further expansion of power plants is not seen as critical, by the University.

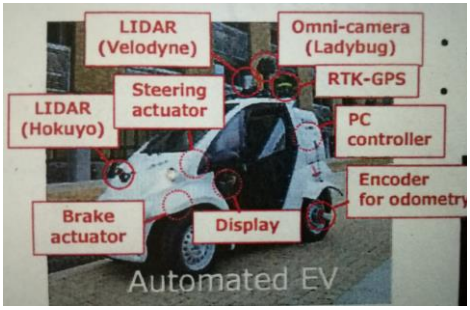

Fig 6 - Sensors @ autonomous car

Fig 7 - Internal life of the automated vehicle

Regarding to the autonomous mobility, the University has greated a vision, the Aobayama Smart Mobility Vision, see figur 8.

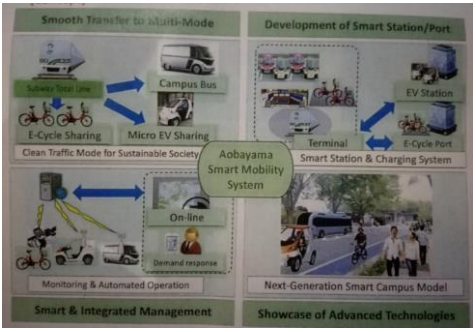

Fig 8 - Aobayama Campus Smart Mobility Vision in planning

For this they built the ITS campus. In addition to the technical challenges, people also want to be prepare, for this new kind of mobility. This is why good showcases should be established, even for the general public. The University named it "next society

model", or Society 5.0. See illustration on figure 2.

After the lectures, the students could test some of the electric cars (Fig. 9) and bicycles.

Fig 9 - The students enjoyed the ride with the electric- powered small transport.

The produced car itself, has little impressed, see Figur 7. The max. Speed is 20km / h for autonomous driving. The technology on the vehicle is visible and extensively installed. They are testing the various sensors. The main sensor is called “Ladar”, i.e. a combination of radar + GPS, Fig. 6. The price of this sensor is chancing very much. Linux is the operating system.

Overall conclusion

During this site Visit, there was quite very much information transported in a short time. More time would have been needed. The progress in autonomous driving has not been apparent in practice. However, the numerous research areas are interesting. As well as the initial results and selected approaches. It is advisable, to carry out a technical excursion again in a few years. Then the ITS Centre can really show what might is possible and will be. Potential is given in particular because of the size of this "foundation".

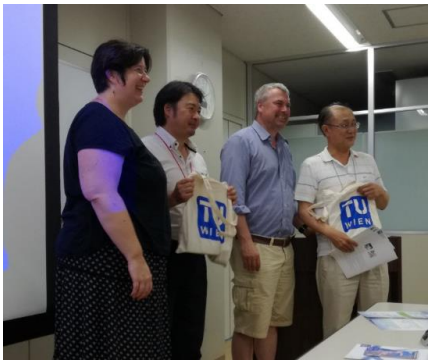

Fig. 10 - Presentation of the guest gifts by the representatives of the Vienna University of Technology to the lecturers of the Tohoku University Sendai.

Literature and sources

All photos were made by the author of this report, the slides belong to the Tohoku University Sendai of Sendai.

Written by Thomas Greiner, Student Civil Engineering, 28.8.2017 TU Vienna.