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Scientific

# On Generic Properties of Extended Environment Values

Mikio Sasaki,  
Music Scene Research

Tuesday, October 31, 2017  
09:45 - 11:15 - TS44 Sharing the Ride <512A>

**Next Generation Integrated Mobility:**

Driving Smart Cities

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# On Generic Properties of Extended Environment Values

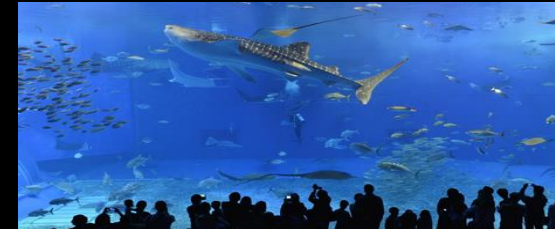
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Montreal at the 24<sup>th</sup> Annual ITS World Congress 2017

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# Introduction

# Around 2020, it is expected that the **New Mobility** will emerge and it will flow into **tremendous Convenience Market** largely. This is showing the **Values of spatio-temporal movements** of human will **drastically change**.

# **Urban Planning** is widely going on towards the Realization of “**the Convenient society** in which we can be happy **even if walking, and my car, share car, public transportation and bicycle can coexist.**”

# In this presentation, **Feeling Flow** and **the Environment Values** which will become **the source of Moving Demand** are proposed to seek **the smoothing means for the People Flows**.



**German** In **TTT** (Technology, Talent, Tolerance), **No.1** of 413 cities is **Erlangen** (100,000 people) , Originator of **Compact City**. **Munch is 2<sup>nd</sup>**.

25% have Foreign roots. **Population flow is the vitality**. City cooperation. Wall → Bird's-eye thinking to change the city. Positive acceptance and anti-racial discrimination foreigners, refugees. Walking the main street of **10 minutes** cormorant crowded, small city atmosphere of calm in the cultural. 2-layer structure of social thought and culture / values / identity Continue to be the latest 400 years, it produced the suits economy era, the development of the city, City center city, fort, university town, High centripetal force, cultural festival, sports, Bicycle traffic, Urban Farm, Corporate Strategy, Leisure is to volunteer, Industry, academia and government cooperation.

**France** Livable city **No.1 : Angers**, Strasbourg ::: compact city

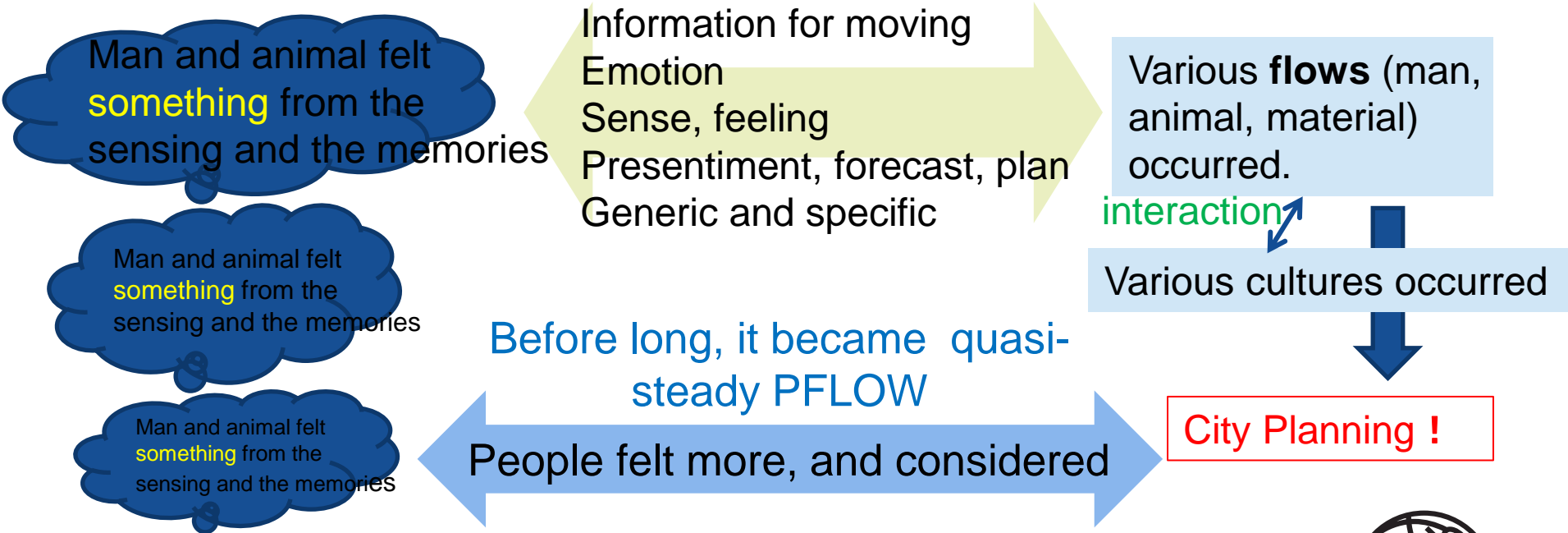
Town walk live in, Pedestrian safety measures, Public transportation, which coexists with car convenience increases, rise of car sharing.

**Creativities of Cities** are not proportional to the population scale, but to **People Flow** !?



# At First, the Environments Exist

From time immemorial, man and animal **are wandering for sustenance to live**



*Before movement, it is good to conceive the target place and environments*



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# Man find the values in the environments

Movement only for living



More comfortable

More something...

POI (Point Of Interest), Landmark



Potential energy EV based on multi-category values on every point on the moving trajectory

Environment Values: EV



EV corresponding to real space  
EV corresponding to virtual space

**Hypothesis: the ideal spatio-temporal movements** are in the states that  
Movements in Real space **match to**  
Movements of **FFLOW** in Virtual space

$$X = \sum_{t=1}^{t2} EV\_GET\{trajectory(real\_space, virtual\_space), situation\}$$

*Then, various FFLOWS are being organized...*



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# Then what is the FFLOW?

*Information* : as for moving demand of users

*Emotion* : especially when arbitration

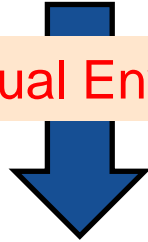
***Feeling*** :vague perception of image

←Now, focus

$$\mathbf{F}(t_n) = (\mathbf{F}_{moving\_demand}(t_n), \mathbf{F}_{feeling}(t_n) \cdots, \mathbf{F}_{emoton}(t_n))$$

$$\mathbf{F}(t_n) \cong \mathbf{F}_{feeling}(t_n)$$

Generate the time series of Virtual Environment Values (comfort potential)



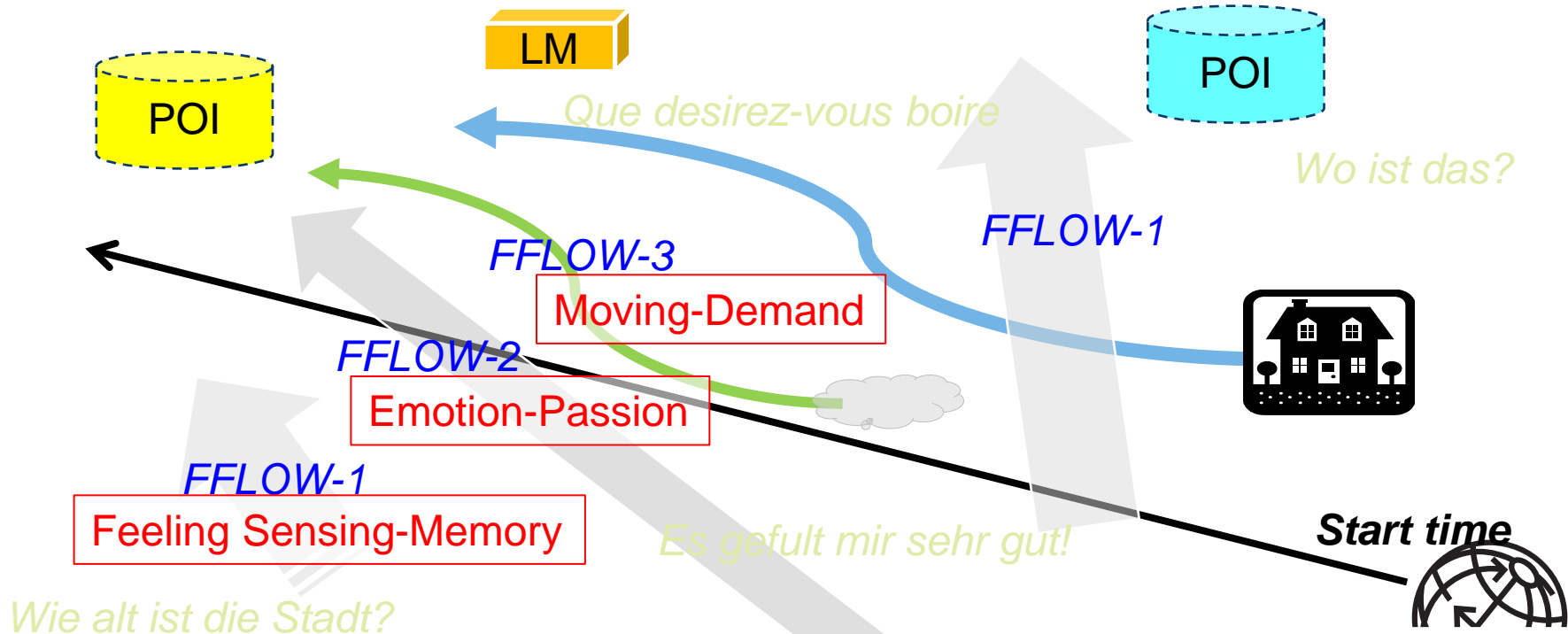
This will **reify** the Ideal Movement states...



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# 3 steps of FFLOW

$$PFLOW(t, x) = FFLOW(t + \Delta U(t), x + \Delta V(x))$$



PFLOW can be predicted from FFLOW !?



# FFLOW is activated by the Image



# Hypothesis : FFLOW maximize the Comfort

Then, what is the comfort potential ?

Features of 100 people (Mover) and  
Features of 100 LMs will enable us to  
Compute the comfort

$$\dot{E} = \dot{U}_D \dot{U}_S^T = W(U_D, W_D) W(U_S, W_S)^T$$

where,  $[W(A, B)]_{ij} = [A]_{ij} [B]_{ij}$

## Mapping to different spatio-temporal regions

# Examples according to the **generic properties of PFLOW**, which are **activated by FFLOW**.

# **Initial values for Mover** are supposed to be common vectors for **basic vocabularies of LM**, which will reduce the input works drastically.

```

.....
// ●LM0: Kochi Castle and park ← Nagoya Castle and park ← Glabor garden
UsrSA[0][0]=5; UsrSA[0][1]=5; UsrSA[0][2]=9 ; UsrSA[0][3]=8; UsrSA[0][8]=5;
UsrSA[0][10]=3; UsrSA[0][11]=9; UsrSA[0][12]=5; UsrSA[0][13]=2;
UsrSA[0][20]=10; UsrSA[0][21]=6; UsrSA[0][25]=7; UsrSA[0][28]=7;//★
.....

```



# Compute comfort from Mover

Comfort :

$$\dot{E} = \dot{U}_D \dot{U}_S^T$$

**Mover**

0: time

1: cost

2: capacity of people

3: accessibility

4: hobby, scene, history

5: weather

6: preference, shopping

7: smoking, drinking

8: lunch, dinner

9: play, sports, marine resort

.....

$$\dot{E} = \dot{U}_D \dot{U}_S^T = W(U_D, W_D) W(U_S, W_S)^T$$

$$E = U_D U_S^T$$

$$= \begin{bmatrix} \mathbf{u}_{D1} & \mathbf{u}_{S1} \\ \dots & \dots \\ \mathbf{u}_{Di} & \mathbf{u}_{Sk} \\ \dots & \dots \\ \mathbf{u}_{Dl} & \mathbf{u}_{Sk} \end{bmatrix}^T = \begin{bmatrix} \mathbf{u}_{D1} \\ \dots \\ \mathbf{u}_{Di} \\ \dots \\ \mathbf{u}_{Dl} \end{bmatrix} \begin{bmatrix} \mathbf{u}_{S1}^T \dots \mathbf{u}_{Sk}^T \dots \mathbf{u}_{Sk}^T \end{bmatrix} = \begin{bmatrix} \mathbf{u}_{D1} \mathbf{u}_{S1}^T \dots \mathbf{u}_{D1} \mathbf{u}_{Sk}^T \dots \mathbf{u}_{D1} \mathbf{u}_{Sk}^T \\ \dots \\ \mathbf{u}_{Di} \mathbf{u}_{S1}^T \dots \mathbf{u}_{Di} \mathbf{u}_{Sk}^T \dots \mathbf{u}_{Di} \mathbf{u}_{Sk}^T \\ \dots \\ \mathbf{u}_{Dl} \mathbf{u}_{S1}^T \dots \mathbf{u}_{Dl} \mathbf{u}_{Sk}^T \dots \mathbf{u}_{Dl} \mathbf{u}_{Sk}^T \end{bmatrix} = \begin{bmatrix} E_{11} \dots E_{1k} \dots E_{1K} \\ \dots \\ E_{i1} \dots E_{ik} \dots E_{iK} \\ \dots \\ E_{l1} \dots E_{lk} \dots E_{lK} \end{bmatrix}$$

where,

$\mathbf{u}_{Ai} = (u_{A(i,1)}, u_{A(i,2)}, \dots, u_{A(i,j)}, \dots, u_{A(i,J)})$  : Mover vector form ( $A = D, S$ )

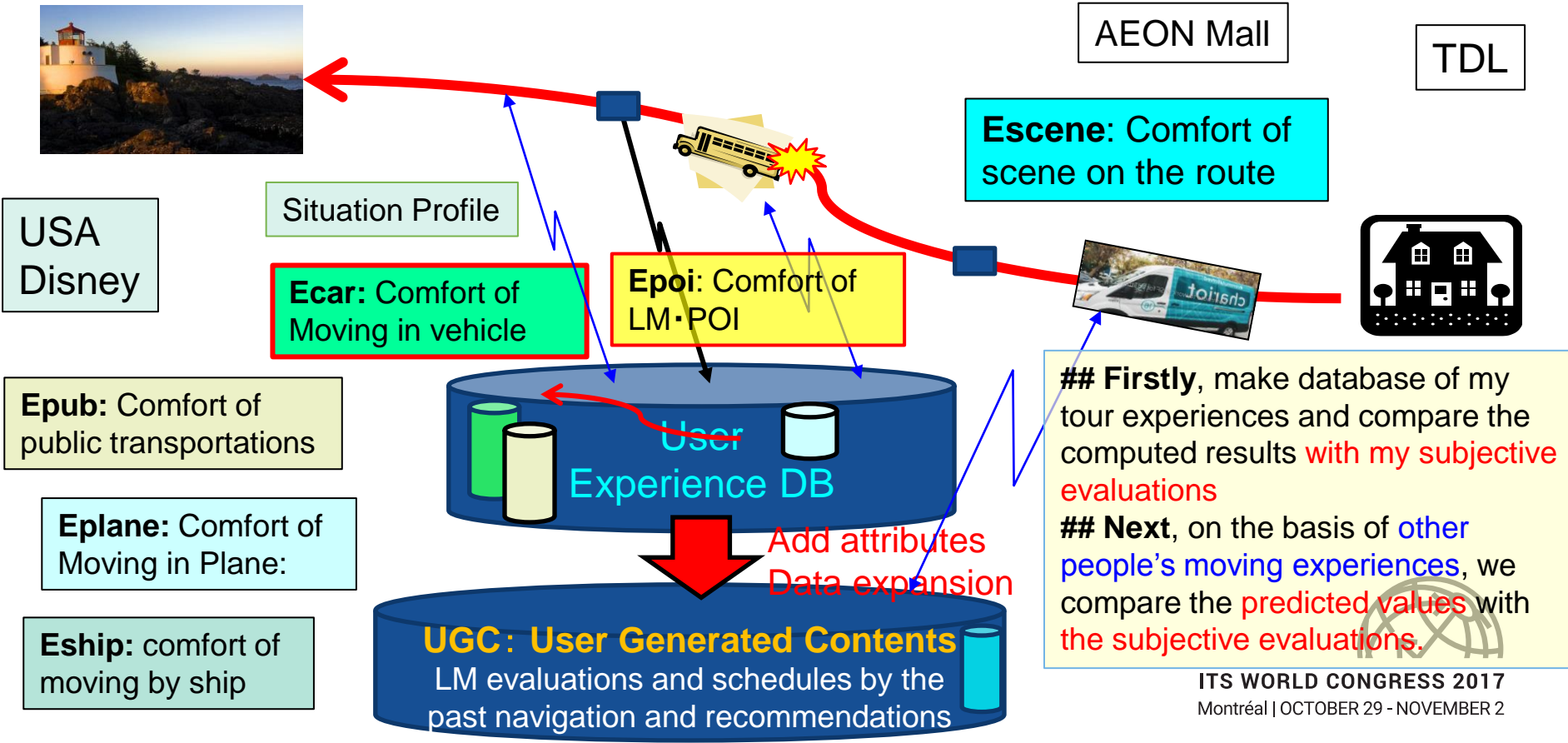
$E_{ik} = \mathbf{u}_{Di} \mathbf{u}_{Sk}^T$  : Comfort potential energy of  $i$ th user for  $k$ th landmark.

$i, j, k$  means the number of users, the number of dimensions of Mover Vector, and the number of target landmarks, respectively.

**Take an Inner product correlation of Dynamic user profile and Static user profile each of which is weighted by User models**



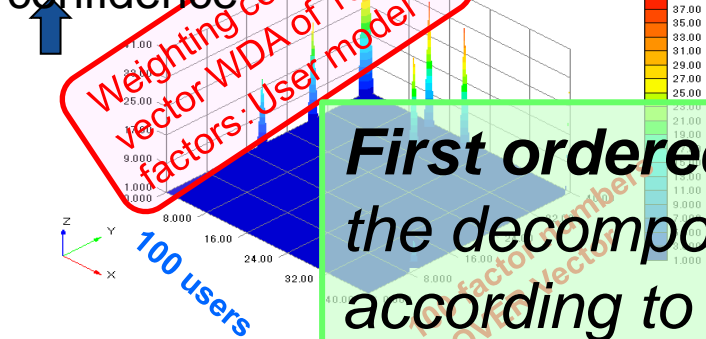
# Predict Comfort from User Experiences



# Towards MOVER on NMF

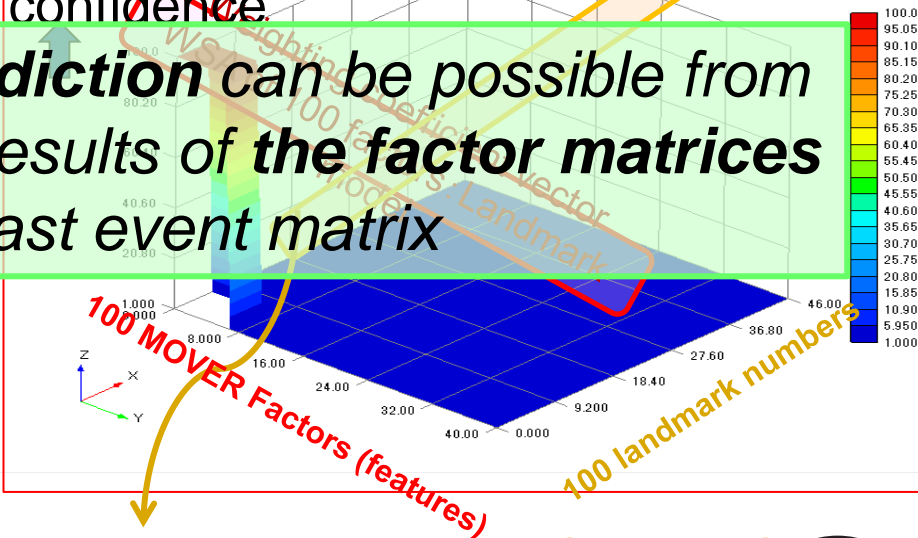
## Dynamic User Profile: $U_D$

confidence



## Static User Profile: $U_S$

confidence

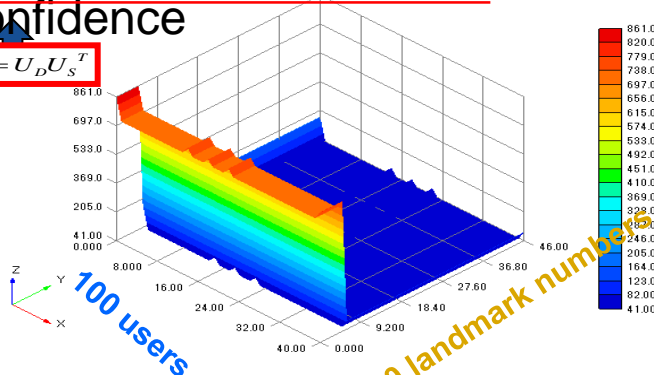


First ordered prediction can be possible from the decomposed results of the factor matrices according to the past event matrix

## Comfort Potential: $E$

confidence

$$E = U_D U_S^T$$



100 dimensional event pattern (landmark) vector which corresponds to the  $R$ th factor



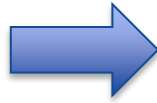
$$\dot{E} = \dot{U}_D \dot{U}_S^T = W(U_D, W_D) W(U_S, W_S)^T$$

# From Mover to Comfort

## Mover code

0: time  
 1: cost  
 2: capacity of people  
 3: accessibility  
 4: hobby, scenery, history, historical place  
 5: weather (comfortable)  
 6: preference, shopping  
 7: smoking, drinking  
 8: lunch, dinner, restaurant  
 9: play, sports, marine resort  
 10: taxi  
 11: walking  
 12: trams, subway, train  
 13: Bus  
 .....  
 20: user experiences  
 21: repeater degree  
 25: Best-10 priority in the target area  
 28: Best-3 priority in the target area  
 .....:

## Comfort potential



$$\dot{E} = \dot{U}_D \dot{U}_S^T = W(U_D, W_D) W(U_S, W_S)^T$$

### Various conditions exist:

**Constraints:** schedule, money, duration, restaurant, accessibility with surrounding facilities, connection, transportation

**Unexpected:** closed, under construction, weather, schedule change.

**Users related:** maturity, repeat number of degree, stay in relative's house, schedule, restaurant preference, transportation means, car mode. Age, preference, visit schedule of passengers.



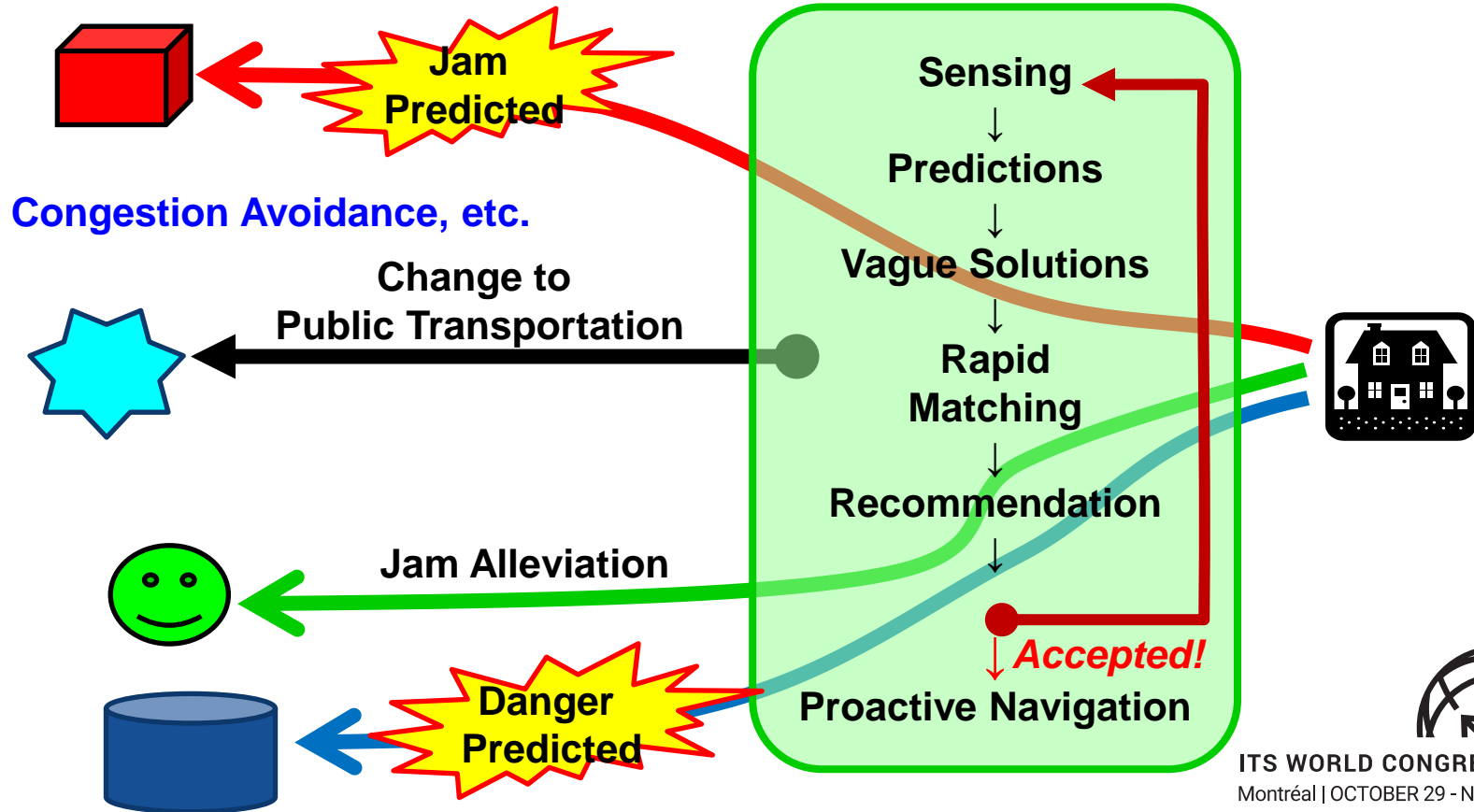
# Comfort Potential for Vehicle

- # path correctness, not distant, **not taking too much time**
- # **beautiffulness** of surrounding scenes
- # **rest spaces, shopping places, sightseeing spots** are appropriately located
- # **easy to drive** (road width, coming vehicles, number of lines, paving degree )
- # **good weather**, clean air
- # **easy to look around**, not dangerous
- # **rare congestion, few large vehicles**
- # **passengers** will not become boring and can maintain **good conditions** physically
- # Guide indication board at **important position** makes it **easy to understand**
- # easy to drive in tunnel
- .....

***CONNECTED will reach the total comfort !?***



# Service Image of Comfort





# Case Example: Visit Kyoto in Autumn



**11/3: Kyoto**  
11/4: Kyoto  
11/5: Kobe

Select  
100 users

Define  
100 LMs



Select LM set

Experienced schedules  
Subject evaluation

**User Model**

- # Time priority
- # **time priority + personal event**
- # Schedule adherence
- # **restaurant reservation**
- # Taxi based moving model
- # priority on train & bus + additional taxi
- # **Priority on specific LM**
- # priority on cost # rain or shine
- # **priority on fine weather**
- # priority on shopping
- # **a little bit distant LM based**

**Mover code**

- 0: time
- 1: cost
- 2: capacity of people
- 3: accessibility
- 4: hobby, scenery, history, historical place
- 5: weather (comfortable)
- 6: preference, shopping
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- .....
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**MAIN CONDITION**

- # **personal event**
- # weather # baggage
- # price of public transportation
- # **No. of moving person:1**
- # **road condition, status**
- # time required
- # clothes
- # time zone
- # what you want to buy
- # **other possible POI**

# minimum input of preference orders (only for important parts, otherwise interpolation. # minimum input of Mover vector (sub-vector can be copied between different areas using generic properties and LM classes.) # rapid matching

UsrSA[100][100]

UsrDA[100][100]

WDA[100][100]

WSA[100][100]

Pref1[100][100]

Pref2[100][100]

#minimum input  
#Rapid matching on multi-dimensional evaluators

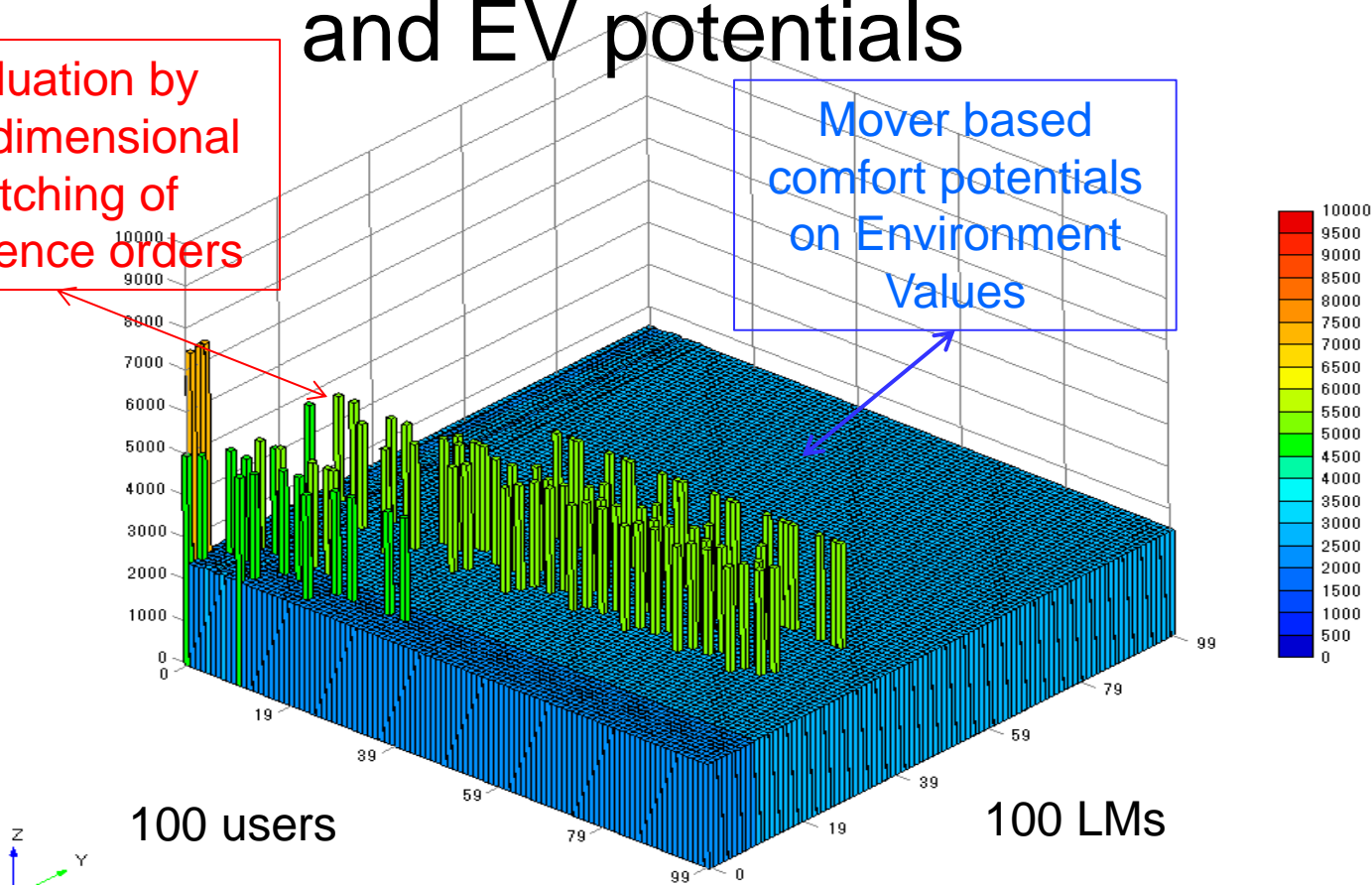
Comparative evaluation and improvement

ITS  
Recommended schedule  
Comfort prediction

# Evaluation of comfort by preference orders and EV potentials

Evaluation by  
Multi-dimensional  
matching of  
preference orders

Mover based  
comfort potentials  
on Environment  
Values



# CONCLUSION

- # **Moving demand prediction** method is proposed around the **comfort**.
- # **Feature vector Mover** which describes **the environment values** are newly proposed regarding POI and LM.
- # We tried the total evaluation of **the comfort potential** and **multidimensional stable matching** using the preference orders.
- # Concept of **feeling flow** is proposed and its relation to the PFLOW is investigated.

## NEXT

- # **People navigation** from the new points of view that **Feeling Flow** is presumed will be tried for the **congestion avoidance** and **comfort improvement** by **the rapid presentations of vague solutions**. We will firstly evaluate **the moving experiences**.
- # On the basis of **FFLOW predictions**, we will consider the machine which can **originally generate the spatio-temporal trajectories** and also **create the time series of decisions** so that they can be applied practically.



## Sources of Reprinted Photos in this presentation are as follows:

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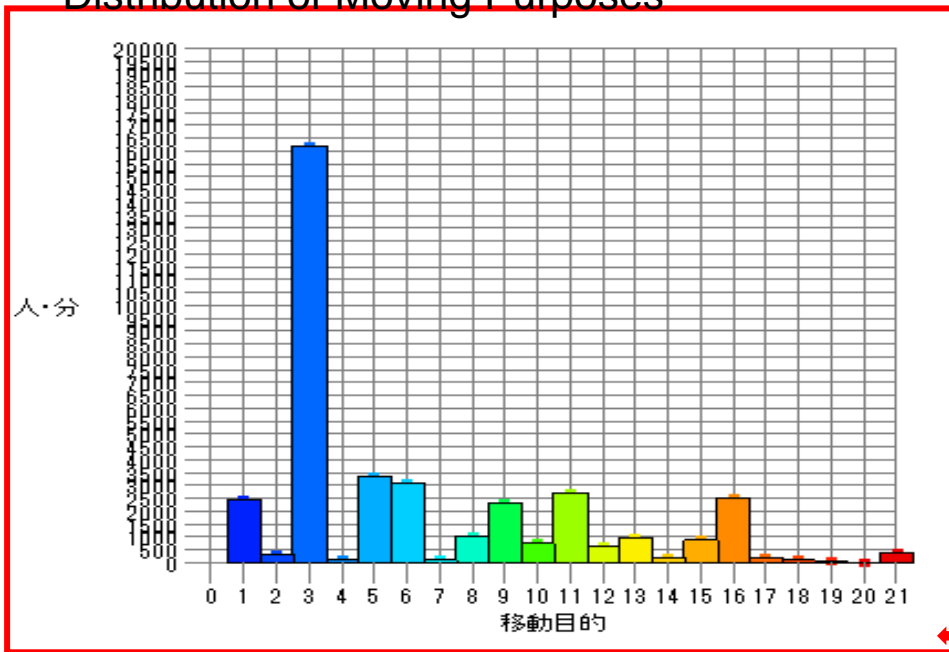
**Thank you for your attention !**

*Additional slides follow for Q&A.*

# Grab the Undecided PFLOW

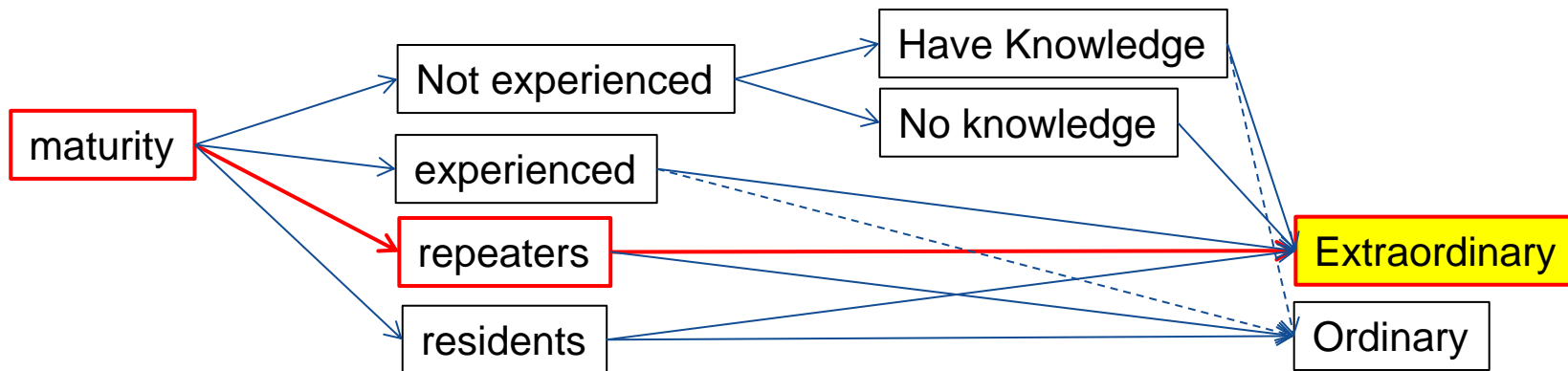
Distribution of Moving Purposes

Grab the undecided PFLOW of Moving Demand



PFLOWs of 20 thousands of people from Chukyo area (Japan) in 2011.11.5 (Sat.) are extracted and analyzed regarding moving purposes for the 1km square around Nagoya station, which showed the above results. The right figure shows “0: Others” are no doubt dominant. This means {vague moving, multi-purpose, secret, impossible to judge}. This is partly because the unit is “person minute”.

# User Experiences



## Estimated confidence for moving demand and extraordinary on LM and user classification

|                                | Sightseeing     |                   |                   | Residents  | Traffic means         |
|--------------------------------|-----------------|-------------------|-------------------|------------|-----------------------|
|                                | Not Experienced | First experienced | Repeater          |            |                       |
| Nagoya AEON Mall               | H/M/L           | Extraordinary H/M | Extraordinary M/L | Ordinary H | Train, Car            |
| Nagoya Gate Tower Bldg         | H/M/L           | Extraordinary H/M | Extraordinary H/M | Ordinary H | Train Car             |
| Sakae Department Stores        | H/M/L           | Extraordinary H/M | Extraordinary M/L | Ordinary L | Train Car             |
| APITA, Valor (Shopping Center) | H/M/L           | Extraordinary M/L | Extraordinary M/L | Ordinary M | Car, Walking          |
| Nagasaki, Glover garden        | H/M/L           | Extraordinary H   | Extraordinary H/M | Ordinary L | Public Transportation |
| Kochi, Shimanto area           | H/M/L           | Extraordinary H/M | Extraordinary H/M | Ordinary L | Train, Bus, Car       |

# Structure of Experimental System

There is no such as a new creation in the world, it is just the discovery of a (*Gaudi*)

Prediction, recommendation, matching are commonly solved.

## Effect and Function

- # Reduce fatigue (Big Data possible)
- # Health (Big Data possible)
- # Comfort (before the Big Data aggregated so as not to be affected by **dynamic trend change**)

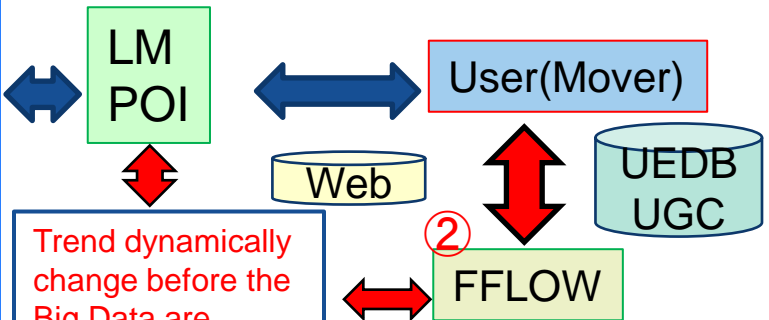
Rapid Matching which optimize the effects according to the user

- # Common platform for different Appli.
- # Hardware: signage, camera, sensor, PC
- # Database : User Experienced DB (UEDB), **User Generated contents (UGC)**

### ① EVmatching + EVoptmization

Trustee cooperative filter and collective intelligence will raise the prediction rate before the big data are accumulated.

### ③ Mover Code



Trend dynamically change before the Big Data are accumulated.

- 0: time
- 1: cost
- 2: capacity of people
- 3: accessibility
- 4: hobby, scenery, history, historical place
- 5: weather (comfortable)
- 6: preference, shopping
- 7: smoking, drinking
- 8: lunch, dinner, restaurant
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- .....





# When FFLOW activates PFLOW

# virtual spatio-temporal space for every user will become closer to the real spatio-temporal space as much as possible, through the real movement, experience, conversation.

# where, it is within the required field. Ordinary people will not consider what exists under the floor, or, within the building passing by. There would be a lot of things and materials which are not necessary to know forever.

It is a **vague solution** other than the recognized results on the basis of the appropriate **collective intelligence**. Under this confidence and the vagueness, evolutions and schedule achievements will go on.

Machine will generate the moving demand prediction within the virtual spatio-temporal spaces, namely, the time series of autonomous moving will.

If this will be done for the machine by the machine

Virtual spatio-temporal space left behind the FFLOW is a vague image of phenomena.

Estimate the FFLOW of Machine →  
Prediction of real MFLOW →  
Decision of moving will

PFLOW will be triggered by this image : PFLOW Prediction using **FFLOW Estimation**

# When applying to human, it will contribute to the smooth PFLOW and acceleration of decision.

# in vehicle equipment generate the room for the time.

# FFLOW of Machine will generate the machine's creativity and idea.

# The computer which has creativity will emerge on the basis of comfort potential.

# From Vague Solutions to Recommendations

