Data Processing for Digital Ensemble of Cities to Simulate Catastrophic Disaster

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1. Disaster Simulation needs programs and data

Developing advanced large-scale numerical simulation of natural disasters of earthquake, tsunami, flood and inundation for Kobe City and other urban areas in Hyogo Prefecture bridge between Advanced Science and Local Government

Solvers have been awarded in SCs

Automatic builder of Urban structure model

“Data Processing Platform” is applied for a patent
Large Scale simulation and AI coming together
[Ichimura et. al. Univ. of Tokyo, IEEE/ACM SC17 Best Poster
2018 Gordon Bell Finalist]

130 billion freedom earthquake of entire Tokyo
(2018 ACM Gordon Bell Prize Finalist,
SC16,17 Best Poster)

Soft Soil

<100m

Earthquake

Too Many Instances

Candidate Underground Structure 1
AI Trained by Simulation to generate candidate soft soil structure

Candidate Underground Structure 2
They developed faster solver, and it is necessary to build “digital cities” for applying it in the real world.
Applications of DPP

A variety of data and simulations will be connected by DPP and form a framework.
Digital twins of automobiles, turbines went forward

Digital twins of cities are in progress but they have shapes... only
Applications of DPP

To build digital twins to simulate “complex disaster” as DIGITAL ENSEMBLE

Digital Twin in Estonian city
From report of CIVITTA (2018)
Vision of e-construction platform
Importance of simulation

Integrate all kinds of geo hazards, water hazards and related hazards

Demand for natural disaster simulations became increasing because disasters frequently take place leading more concern of risk of natural hazards.
Stress force is calculated in a model with structure mechanics
2. Research Achievements

Urban Structure Objects builder as “DPP”

Research for urban hazards requires urban structure objects which represent structure and shape of cities in digital form. However, it takes very long time to develop urban structure objects. We developed Data Processing Platform (DPP) for automatic creation of urban models from maps, official database.

- **M * N patterns**
  - source1
  - target1
  - source2
  - target2
  - source3
  - target3

- **M + N patterns**
  - source1
  - intermediary
  - target1
  - source2
  - intermediary
  - target2
  - source3
  - intermediary
  - target3
2. Research Achievements

Bridge Structure Modeling from 2D CAD

In Japan, we have more than 150,000 bridges having more than 10,000km. Most of them are “plate garter bridge” those have simpler form but not well digitized. It takes more than 40 years to create a digital form by personnel whose population is now estimated as 2000.
DPP can automatically translate the 2DCAD data into 3D shape and FEM data.
It is applied to steel garter bridge with their skeleton
254.2km*25bridge/km*100parts*50000=30B JPY ≒ 300M USD
This will be a core system of Infra-data platform which is designed by MLIT, Japanese government

Society 5.0

• i-construction

• Infra-data platform
Structure of Technology-Research Alliance

Japanese Gov.
MLIT NILIM

Database of Local Gov.

U-Tokyo i-con Lab.

Development
R-CCS
JAMSTEC
U-Tokyo

Index and search system
JACIC

Simulation of all over the city
Technology-Research Alliance

Observer deploy

Order

Collaboration

Order

IT vender etc.

Member company of alliance
We build Japanese “Digital Ensemble” in automatic way by using Data Processing Platform (DPP) for achieving Society 5.0