Engineering Perspective of Geo-Spatial Intelligence in Smart City

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What is a Smarter City?

Information → Intelligent Digitization Networking

Controller → Sensor

Energy → Green

Physical → Biodiversity

Wisdom

Livable

Ecology

Networking

Digitization

Intelligent

Controller

Sensor

Pattern

Controller

Sensor

What Computers Do: Model, Connect, and Engage

建模(Model)
算法+数据结构 (Algorithm+Data Structure)

联结(Connect)
人-机-网络(People-Machine-Network)

参与(Engage)
数字世界-物理世界(Cyber World – Physical World)

Butler Lampson
A.M. Turing Award Laureate
Technical Fellow at Microsoft Corporation
Adjunct Professor of Computer Science and Electrical Engineering at MIT
Connection, more and faster

2025年我国物联网连接数将达到53.8亿，其中5G物联网连接数达到39.3亿。—《2018年中国5G产业与应用发展白皮书》赛迪

Engage, interactive and automatic

Depth perception
Edge calculation
Time-space migration
Collaborative control network
Model, Geo-Spatial Big Data

Temporal
- Agent Based
- Discrete Event Simulation
- System dynamics

Mutil-D
- Domain Integration

Body (3-D)

Polygon (2-D)

Line (1-D)

Point (0-D)

City General Indicator

transport network
underground pipe network

Function Zoning Land use

Mutil-D

Simple
- Data Model
- Small

Complex
- Data Volume

Spatio

Micro

Macro

Evolution of new Geo-Spatial Technology

Earth Observation Network

IoT

GeoMonitor

GeoDesign

BIM

Geo-Spatial Technology

GeoControl

Cooperative object network

GeoModeling

Data Model

Math Model

Geo System

controller

sensor
Geo-Spatial Intelligence Structure and Mechanism

Can we reform traditional transportation?

Amplification of toll gap
Hard condition in field investigation
Repetition of route design
Difficulties in Highway Construction Management
Lag of road maintenance management
Weak basis of road informatization
System Analysis

- People & Goods
- Vehicle
- Infrastructure
- Events

Tech Stack

App Layer:
- Road Investment Decision
- Reconnaissance & Design
- Road Construction
- Maintenance Management
- Operational Management
- Market Credit

Tech Layer:
- Machine Learning
- Spatial Information
- BIM Technology
- Big Data-based Traffic Forecasting
- Data Mining

Data Layer:
- Scientific Support
- Industry Revolution
- Transformation & Upgrading
- Smart Operation & Maintenance
- Community Service

Big Data Processing and Sharing Platform
Case 1, Remote Sensing Recognition

Algorithm, Generative Adversarial Networks

- Generator:生成以假乱真的图像
- 鉴别器：尽可能鉴别真假
- 当鉴别器无法区分真假时，模型训练完毕。
Model Fusing

- Multi-scale fusing

Post-treatment, Rattlesnake

- 利用自动生长、“响尾蛇”等算法，实现路网的自动连接
Building Recognition

Xiamen
Faster

以25平方公里的区域为例，人工勾画路网需8小时/人，利用机器学习自动提取，结合半自动化的后处理，仅需半小时/人。

Better

自动提取路网
原始路网
Traffic Volume Forecast Platform

山西省全路网交通量预测

福建省拟建高速公路交通量预测
Engineer Framework for Smart City

Subject (subjects)
- Computer Engineer

Tool (tools)
- Artificial Intelligence/IoT...

Knowledge (Knowledge)
- relation-rule-pattern

System (system)
- Geo-System

Controler (Controler)
- GeoControl

GeoModeling, GeoMonito r

Feedback

Geospatial Intelligence Helps City Smarter

GeoDesign

GIS

Controller

GeoSystem

Sensor

Measured Output

Measured Error