Paper 4

Building a stepwise-promotion database for areas without 3D city models across all 1,892 municipalities by 2D completion and two-tier hash chunk differential analysis

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Abstract

6,772,689 buildings in all 47 prefectures and 1,892 municipalities (PLATEAU 3D: 95 municipalities, 1,282,287 buildings; 2D completion: 1,797 municipalities, 5,490,402 buildings) are unified in the single schema bldg-db/1 and split into chunks of up to 2,000 buildings (4,581 chunks, 6,474 files, about 305 MB compressed). A two-tier Merkle hash over municipalities and chunks redistributes only changed chunks, and records such as rooms, upcoming inspection dates (reference) and photo pins are carried over unchanged when a building is promoted from 2D completion to 3D measurement.

1. Single schema and chunking

$$N_{\text{total}} = \Sigma_{c \in C} |B_c| = 6{,}772{,}689, \quad K_c = \lceil |B_c| / 2000 \rceil, \quad \Sigma K_c = 4{,}581 \qquad (1)$$

$$b_i = (X_i, T_i, G_i) : \text{base spatial vector} \cdot \text{attribute branch} \cdot \text{completion branch} \qquad (2)$$

2. Two-tier Merkle hash

$$H_{c,k} = \mathrm{SHA256}(\mathrm{Canon}(R_{c,k})), \quad R_c = \mathrm{Trunc}_{48}(\mathrm{SHA256}(\mathrm{Canon}(m_c) \parallel H_{c,0} \parallel \dots \parallel H_{c,K_c-1})) \qquad (3)$$

$$|U^{(t+1)}| = 1 + |\Delta C| + |\Delta K| \text{ (about 5.4 files per municipality promotion; about 99.92\% less transfer)} \qquad (4)$$

3. Non-stop promotion from 2D completion to 3D measurement

$$\hat{h}_i = d_i \, h_i^{\text{meas}} + (1 - d_i) \cdot \{ h_i \text{ or } \alpha \, f_i \text{ or } \alpha \, f_0 \}, \quad \alpha = 3.1 \text{ m} \qquad (5)$$

$$\hat{P}_i = g_i + \sqrt{ (A_i / A(P_0)) } \cdot (P_0 - g_i) \quad \Rightarrow \quad \mathrm{Area}(\hat{P}_i) = A_i \qquad (6)$$

$$T_{\text{promote}}(b_i^{(t)}, \Omega_i^{(t)}) = (b_i^{(t+1)}, \Omega_i^{(t)}), \quad \partial \Omega_i / \partial d_i = 0 \qquad (7)$$

4. Results

Any building in Japan can be matched from an address with about 80–180 KB of traffic, and the information from outside (footprint, height, elevation) is used as the footprint of the Block Puzzle.

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