

Label Freedom: Stable diffusion on Remote Sensing Semantic Segmentation Data Generation

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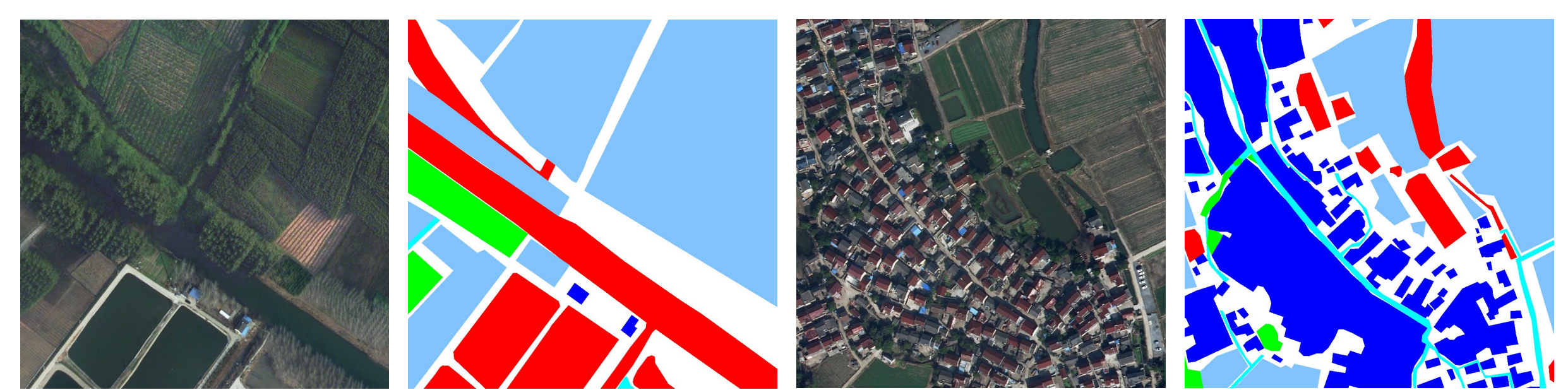
Background

Since 2023, AIGC (artificial intelligence generated content) has shown the performance of AGI (artificial general intelligence) seed. Furthermore, SOTA of supervised downstream task is close to saturation. We took the advantage of stable diffusion, proposed a data generation pipeline. This approach generated semantic segmentation label and image data, and the generated data achieved high accuracy as 0.516 mIoU in LoveDA dataset, which closed to the original dataset result as 0.530 mIoU.

Contribution

1. We implemented the stable diffusion algorithm in remote sensing satellite image generation.
2. We proposed a semantic segmentation image-label pair generation approach based on LoRA and stable diffusion.
3. The generated datasets were validated by Mask2Former algorithm, which achieved high accuracy as 0.516 mIoU in LoveDA dataset, closed to the original dataset.

Dataset



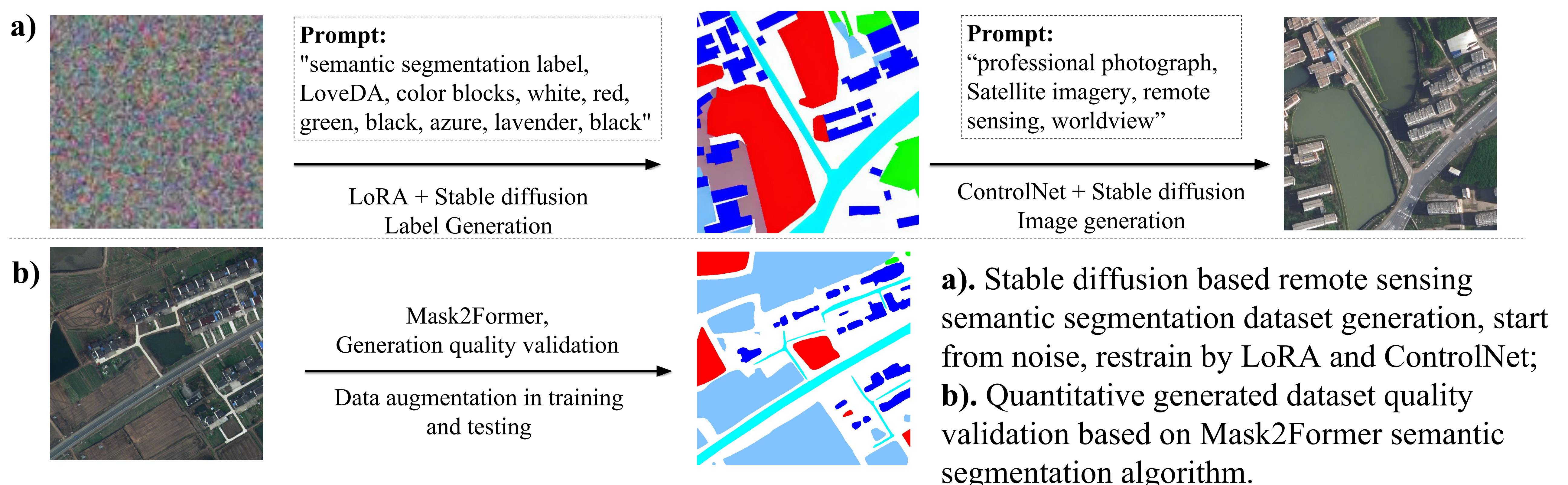
LoveDA dataset:

2522 train, 1669 val, 1796 test, 5987 total.

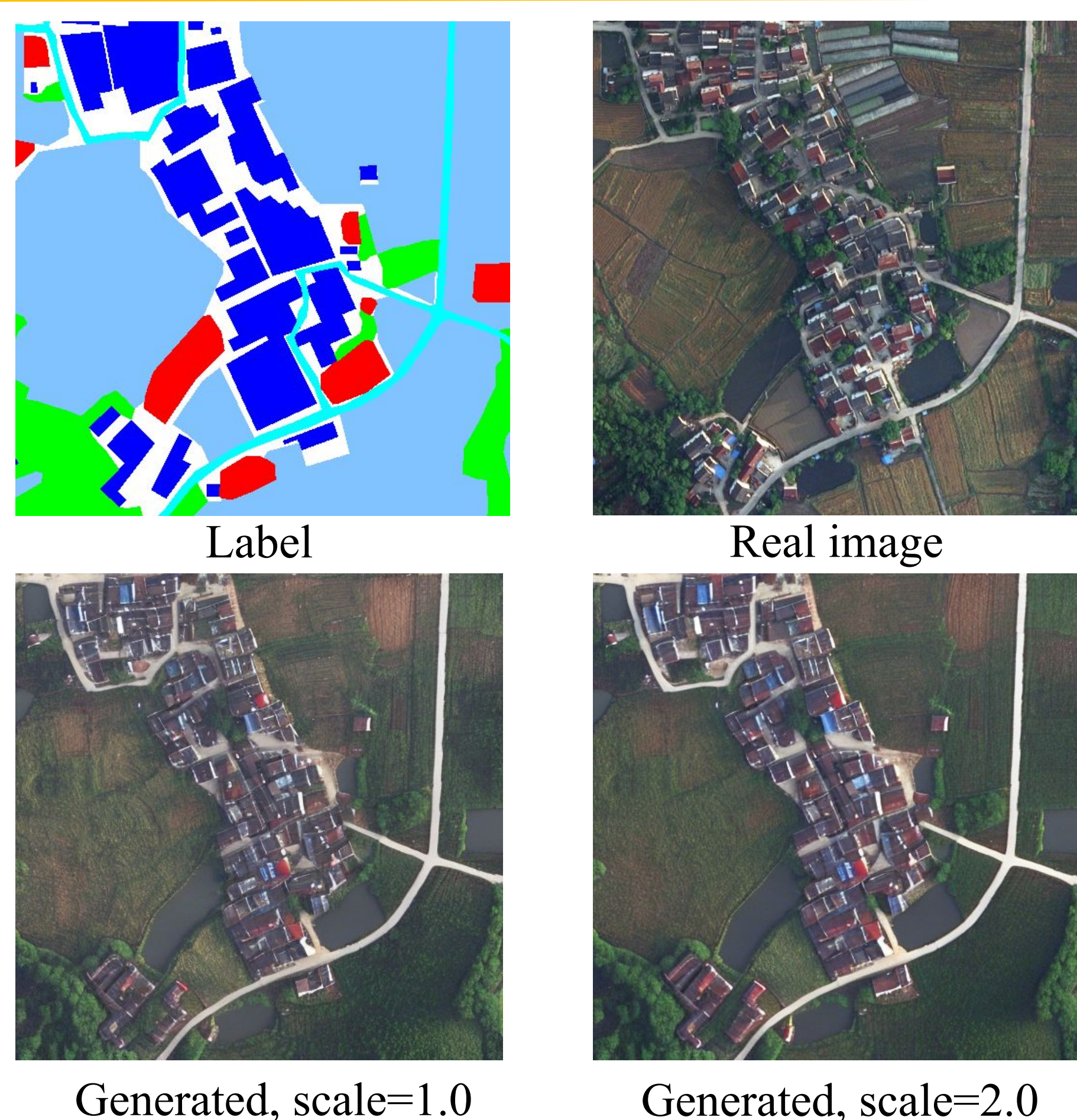
1024 x 1024, 0.3m resolution

B.g., building, road, water, barren, forest, agriculture.

Workflow



Result



As shown on the left images, this approach could be used to generated aerial image in different style and resolution, the scale parameter could be used to control the image fineness.

The generated images have similar performance to manually annotation, thus time and manpower could be saved by our approach. This approach could be generalized to instance segmentation, and for the street view image generation, 3D modeling, etc.

Semantic segmentation performance comparison on generated data and original data

Data	background	building	road	water	barren	forest	agriculture	mIoU
Gen.	0.435	0.594	0.520	0.811	0.159	0.466	0.627	0.516
Ori.	0.464	0.591	0.595	0.818	0.153	0.472	0.615	0.530
Gen. + Ori.	0.466	0.579	0.601	0.812	0.179	0.467	0.629	0.533

As we exhibited in the title, with the approach in this study, we can get rid of the semantic segmentation dataset limitation, save the cost of manual annotation on segmentation or even instance segmentation task.