The 14th International Conference
on Pattern Recognition and
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High-resolution Aerial Image Segmentation for Automated Building Detection

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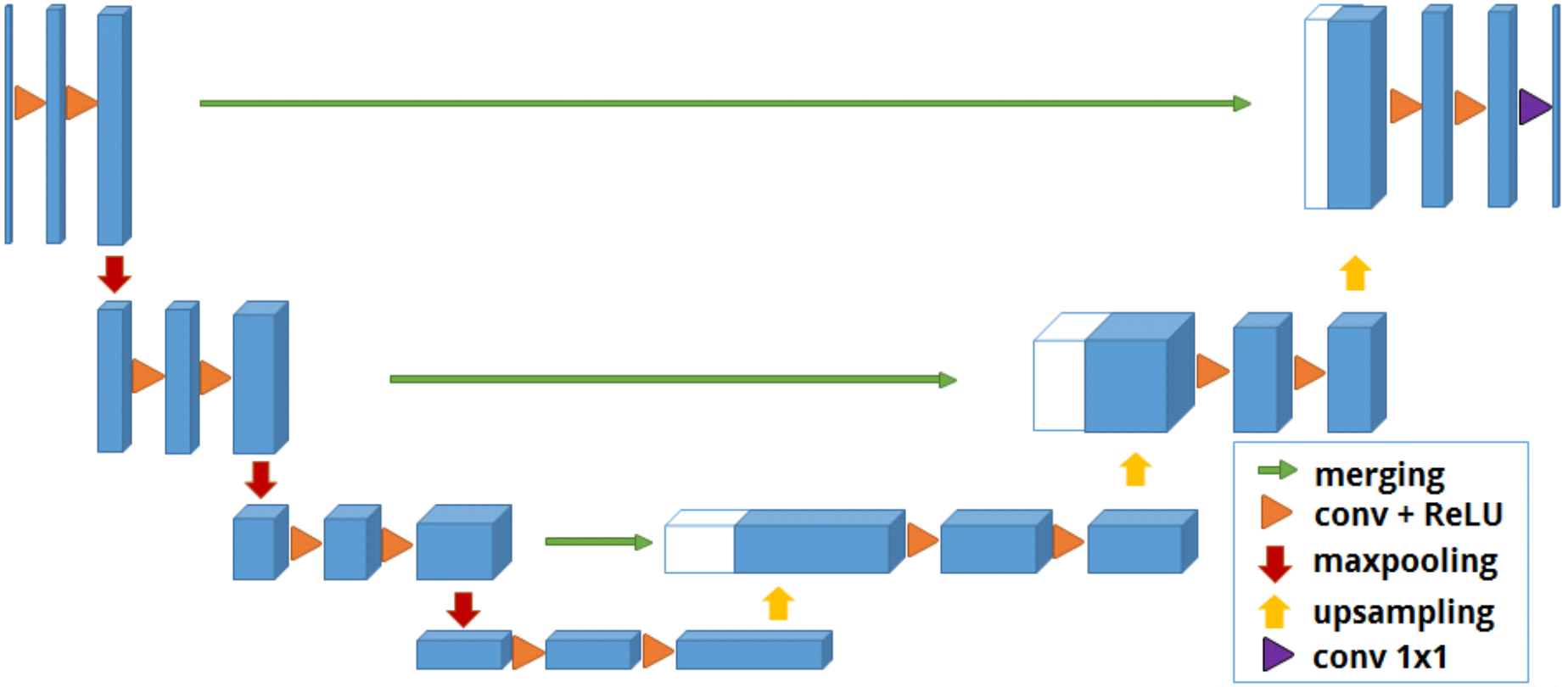
Purpose

Development of effective algorithm for building detection on satellite images based on deep learning methods

Algorithm requirements

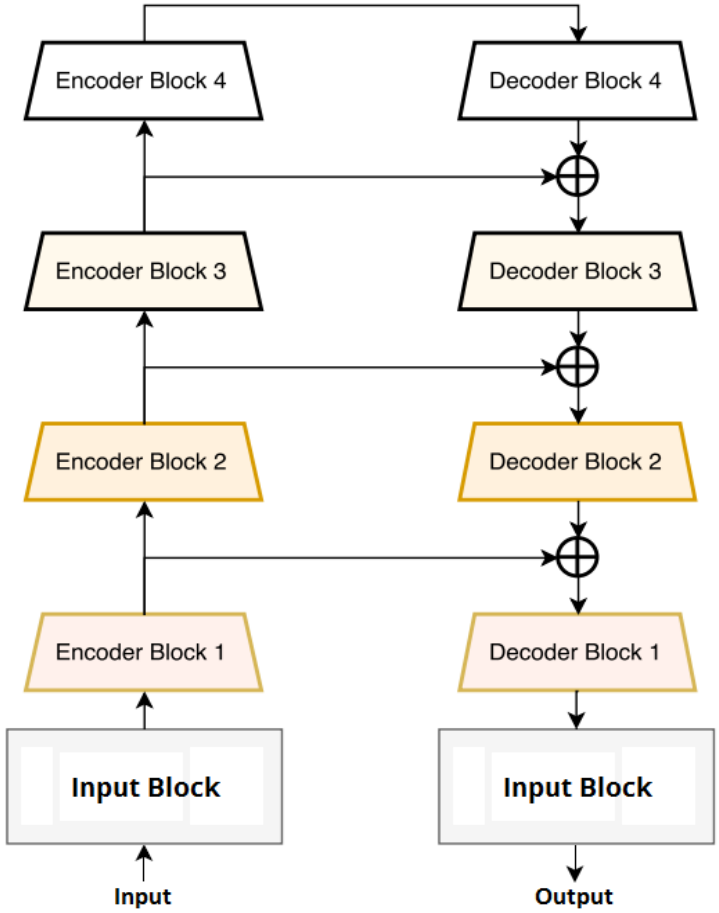
- Take into account the small size of objects
- Be invariant to rotation
- Have enough training examples
- Have an ability to handle huge pictures
- Cope with noise

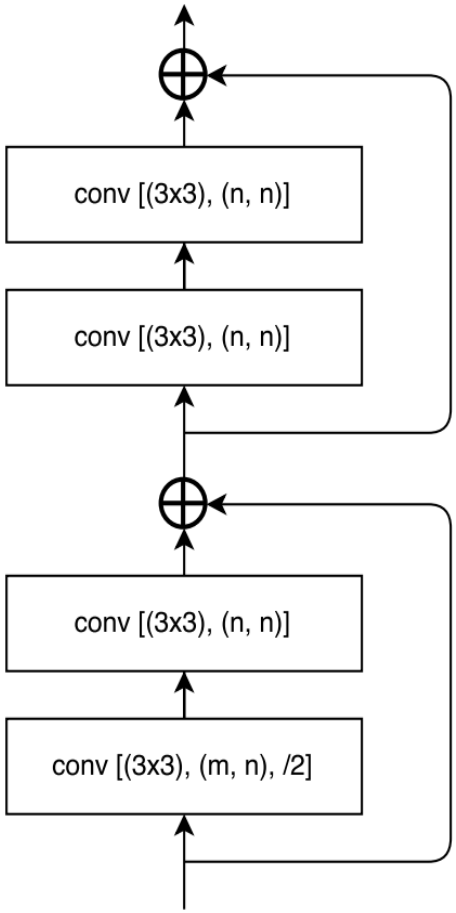
U-Net



Trainable parameters: 7.8 mil

LinkNet

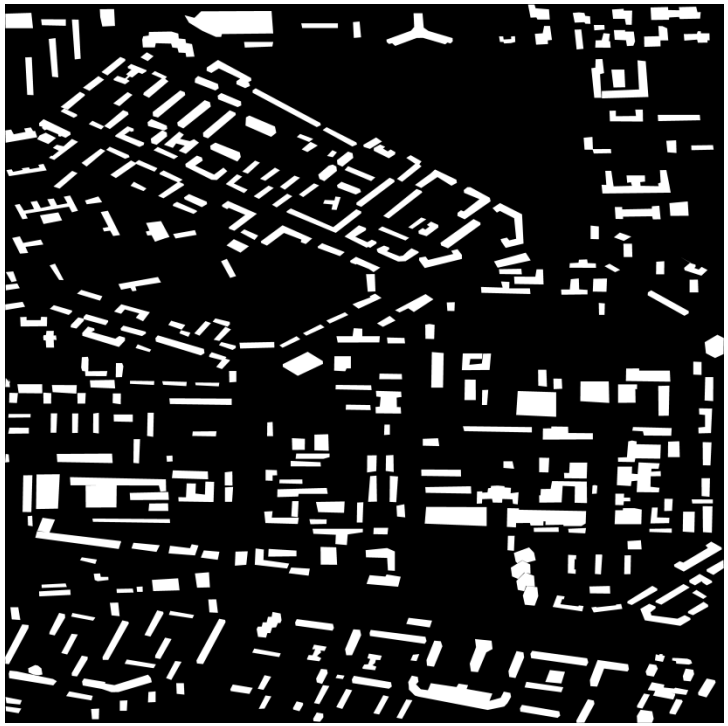




Trainable parameters: 17.2 mil

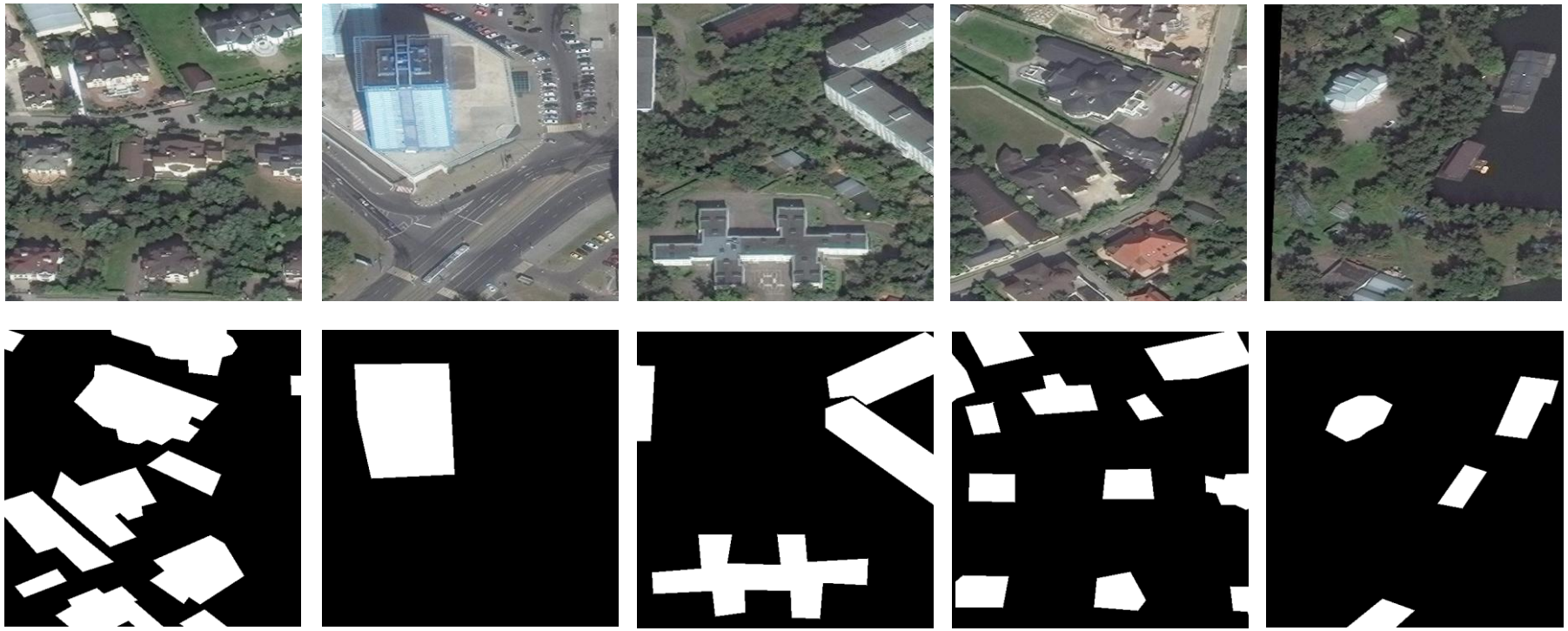
Planet database

- 14 samples in JPG format
- Manual image markup (*https://supervise.ly*)
- Resolution: 8192x8192 px, 0.5 m/pixel
- 3 Russian cities: Moscow, Yaroslavl, Rybinsk

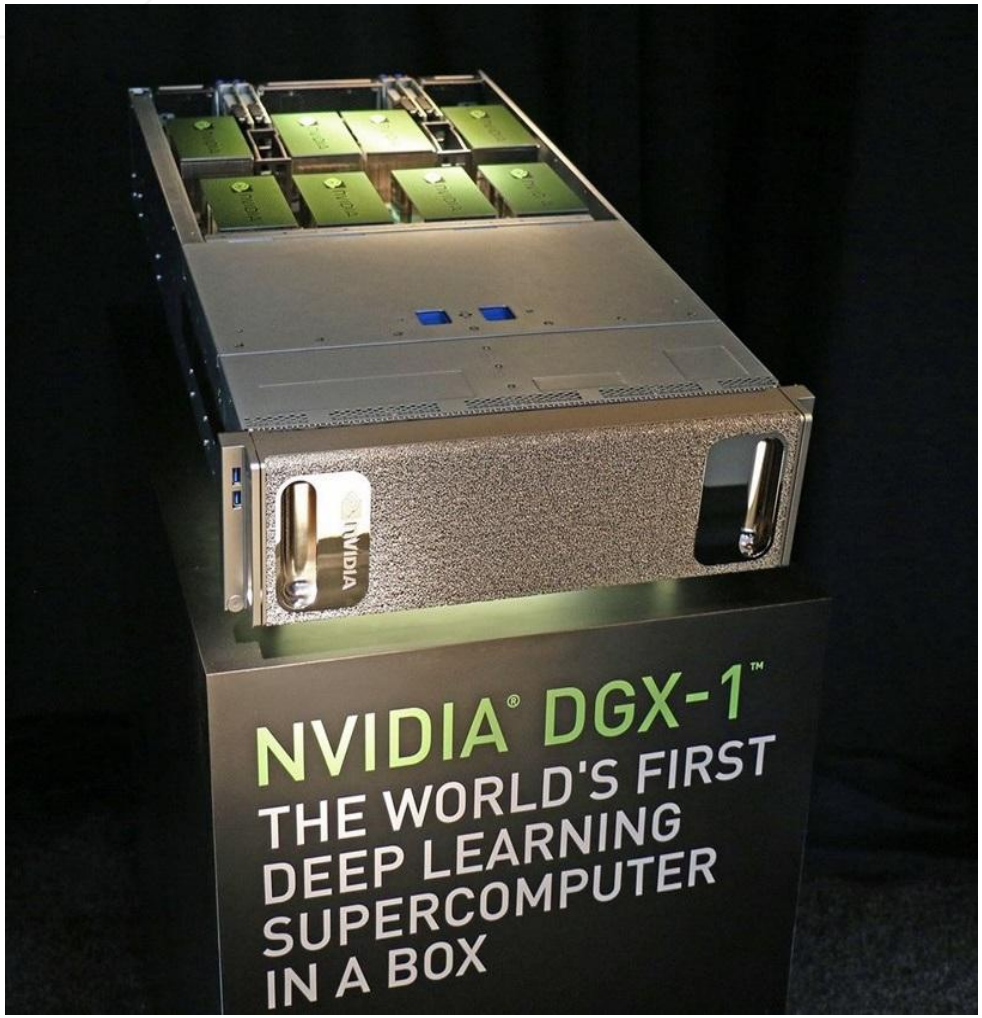


Dataset preparation

- Cropped image resolution: 512x512 px
- Training set: 2611 images
- Test set: 653 photos



Training and testing



Loss function: binary cross-entropy

Optimizer: Adam

Batch size: 18 cropped samples

Epochs (E): 96

Time: 2 hours

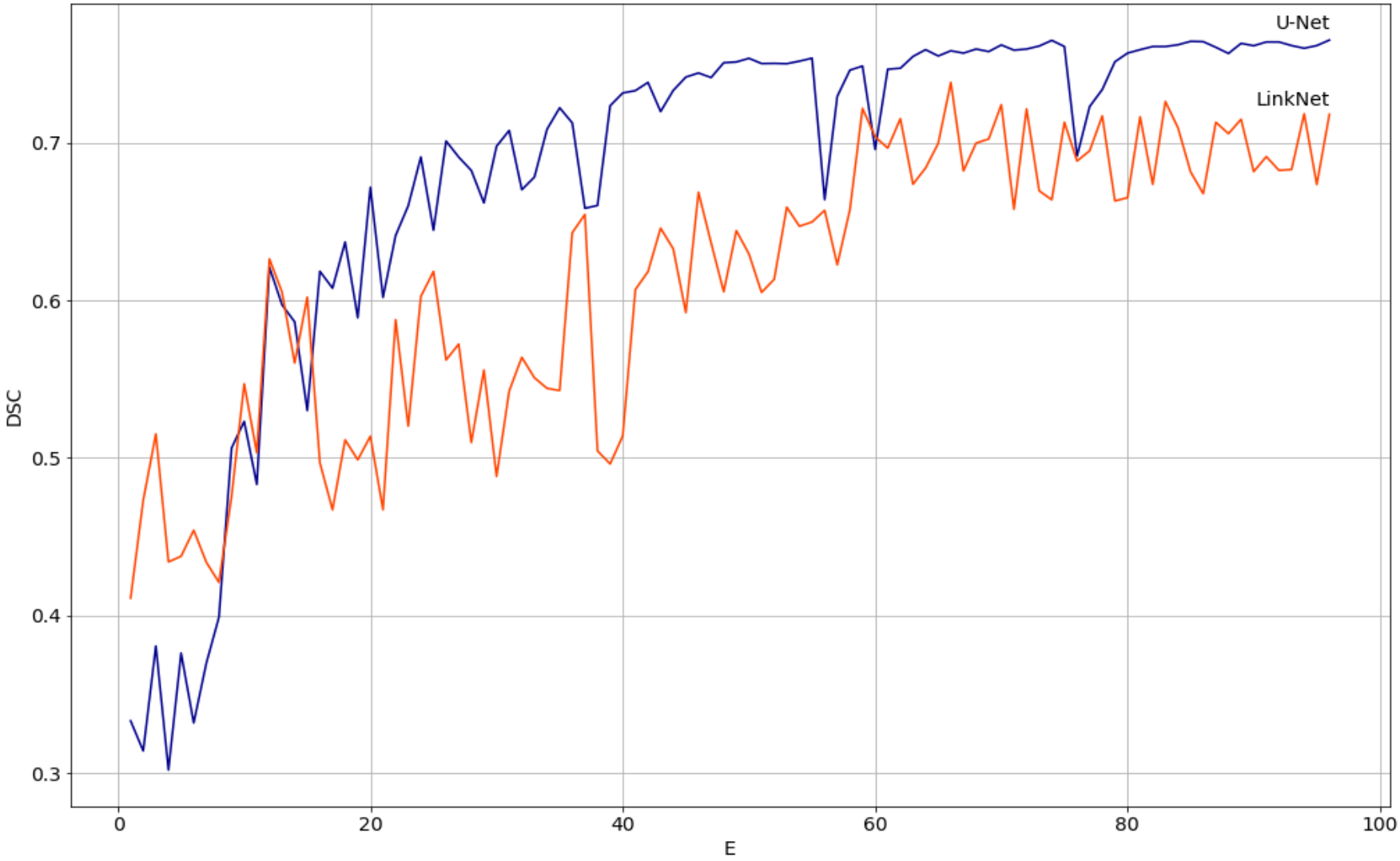
demid.ai

Numerical results

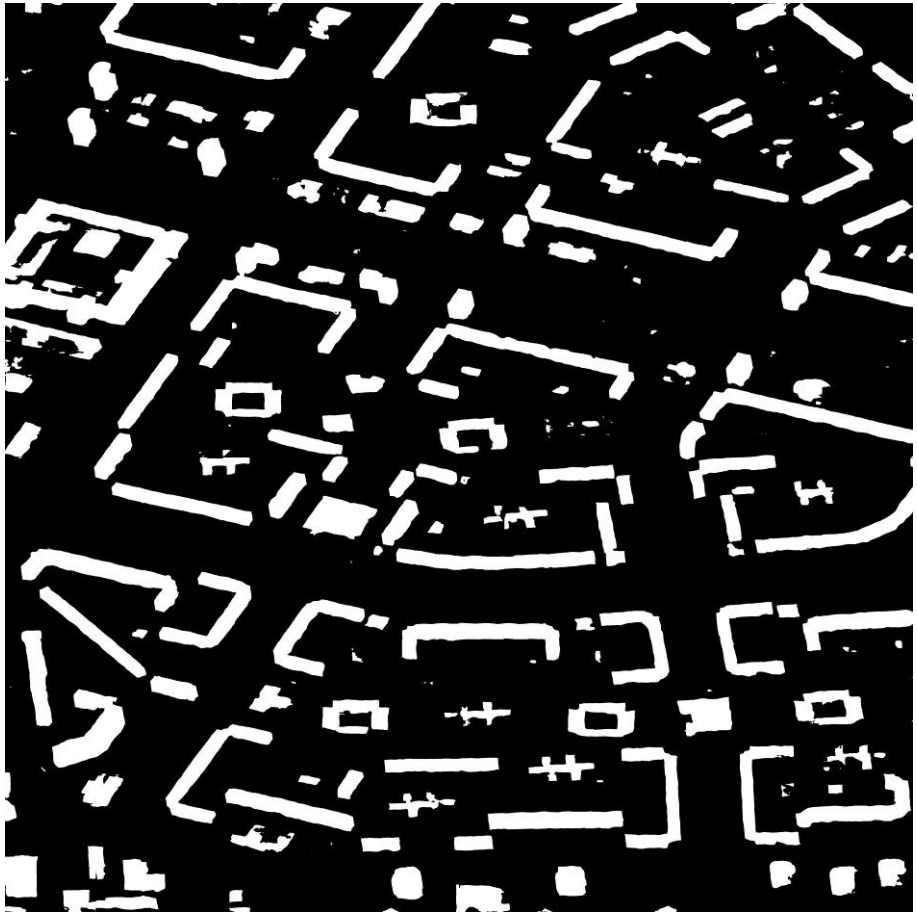
$$DSC = \frac{2I}{S}, \qquad I = \sum_{\substack{x \in X \\ y \in Y}} xy, \qquad S = \sum_{\substack{x \in X \\ y \in Y}} (x + y)$$

Model	**Sorensen-Dice coefficient (DSC)**
U-Net	0.77
LinkNet	0.72

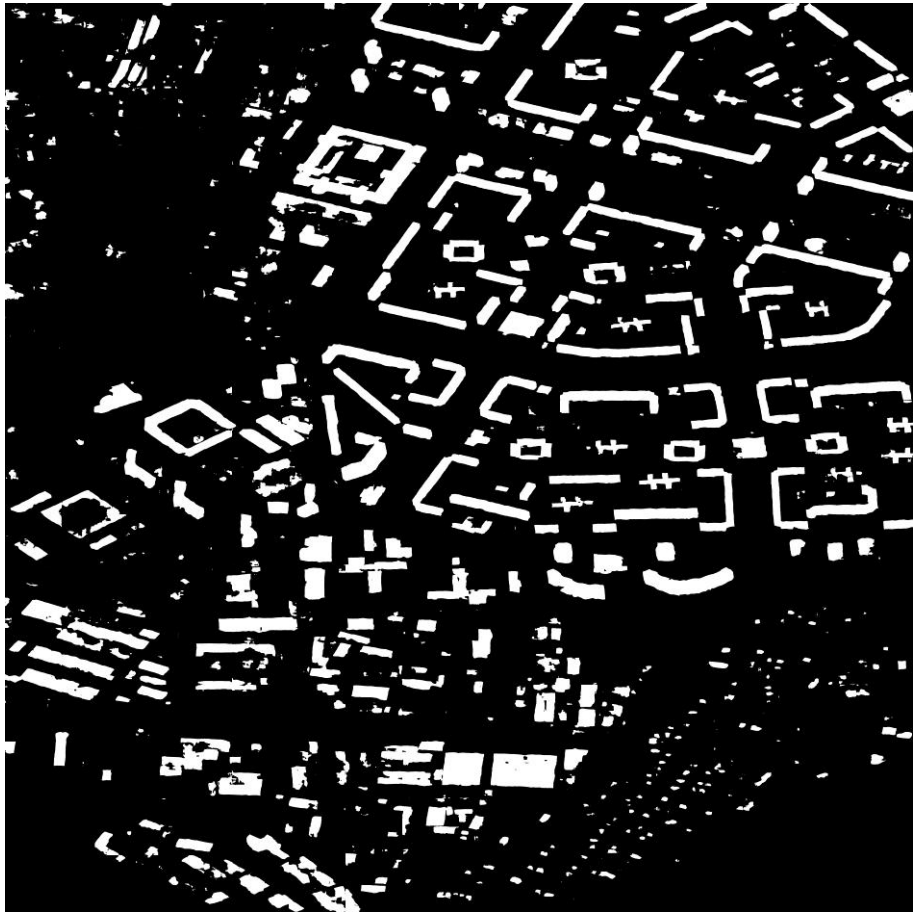
Numerical results



Examples of detection



Examples of detection



Conclusions

- CNNs can be effectively used for building detection on aerial photos
- U-Net and LinkNet were developed to cope with satellite images segmentation
- The training of CNNs was carried out on supercomputer NVIDIA DGX-1
- The best performance was given by using U-Net

Future plans

- Try more complicated loss functions
- Detect building corners
- Try mask search algorithms (Mask R-CNN, Faster-CNN)

Acknowledgment

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