The 24th Conference of
Open Innovations Association -
FRUCT
Moscow, Russia, April 11, 2019

Building Detection on Aerial Images Using U-NET Neural Networks

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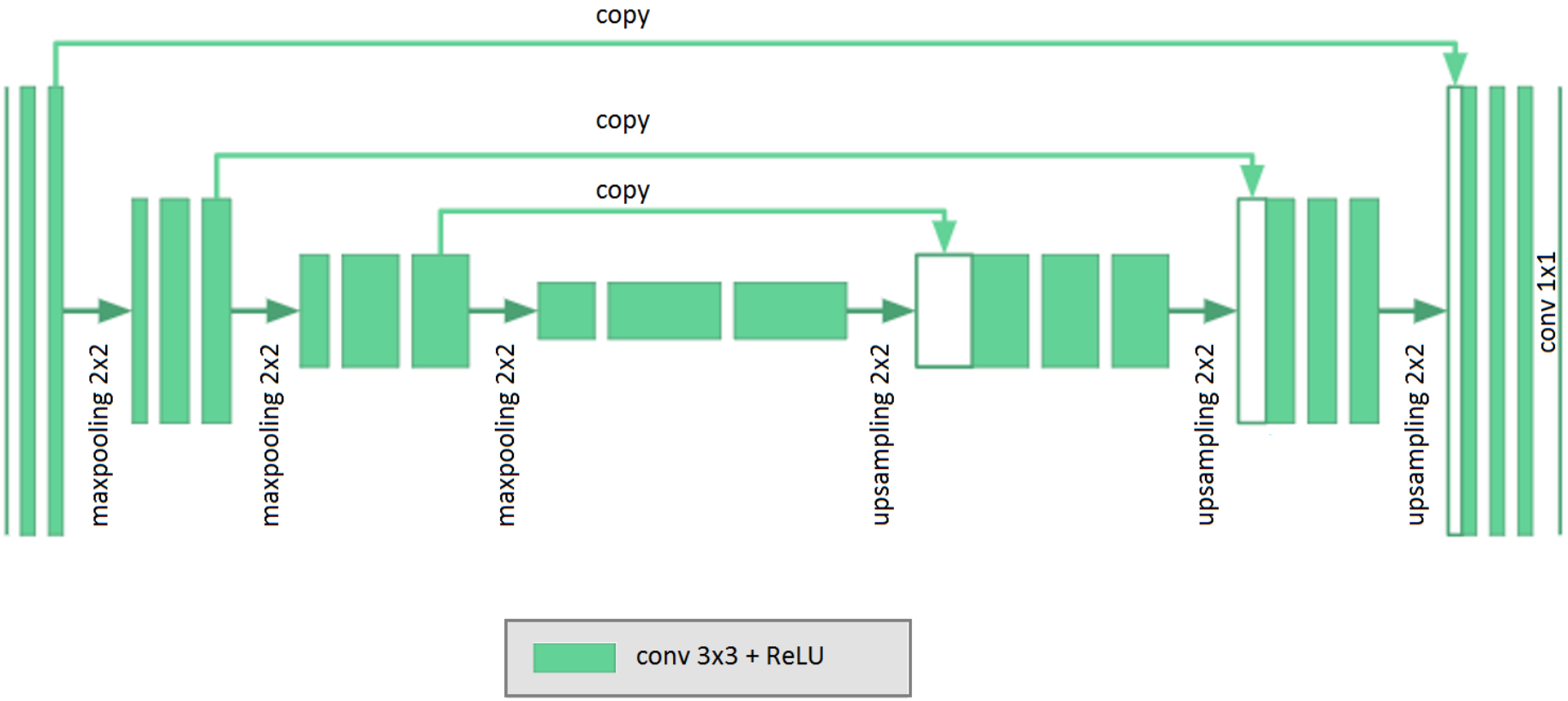
Purpose

Development of effective algorithm for building detection on satellite images based on convolutional neural network

Algorithm requirements

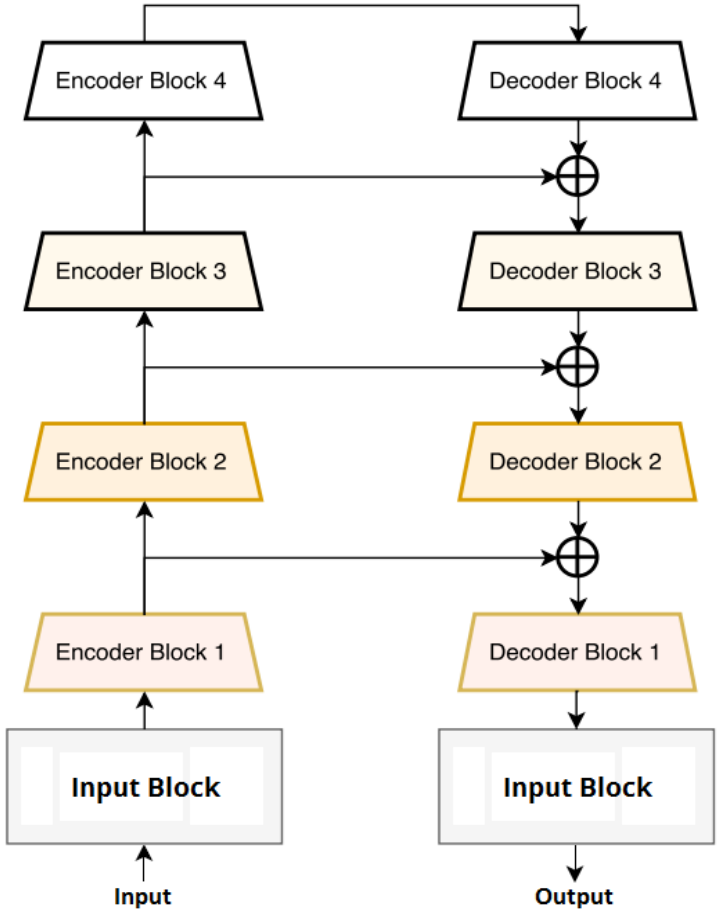
- Take into account the small size of objects
- Be invariant to rotation
- Have enough training examples
- Have an ability to handle huge pictures
- Cope with noise

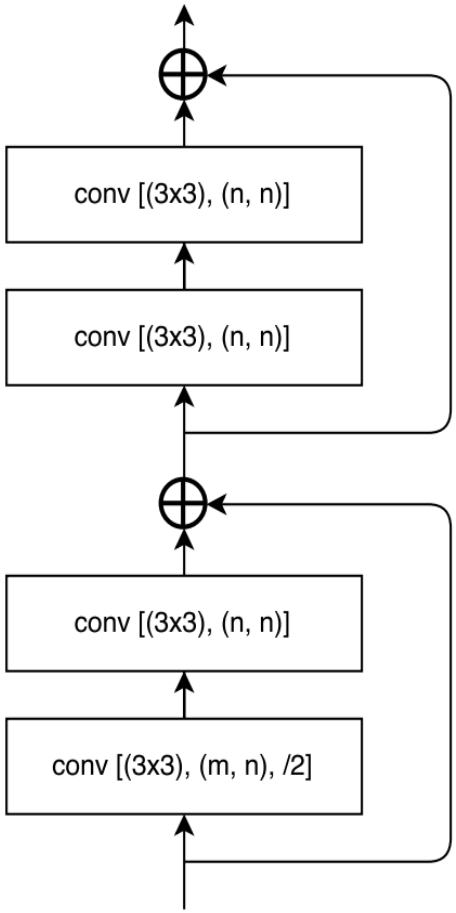
U-Net



Trainable parameters: 7.8 mil

LinkNet

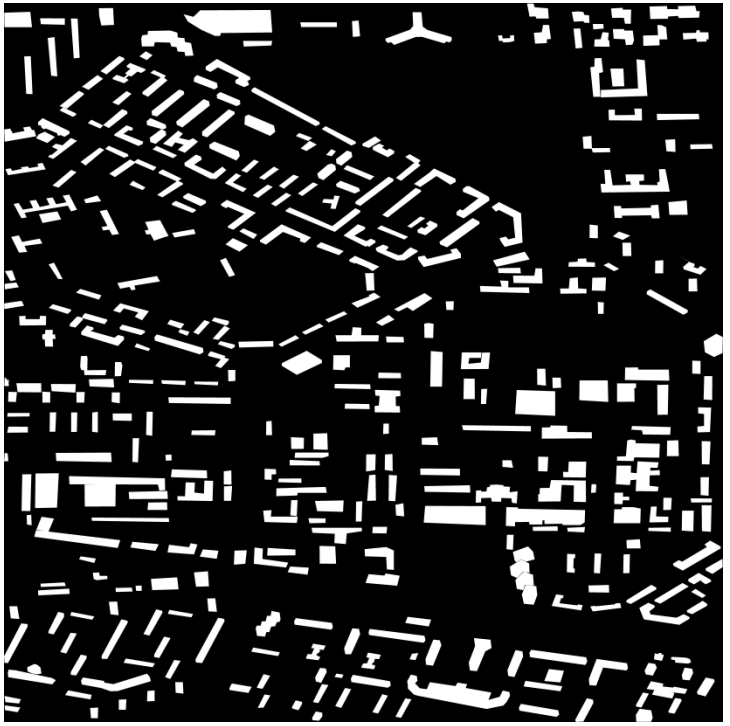




Trainable parameters: 17.2 mil

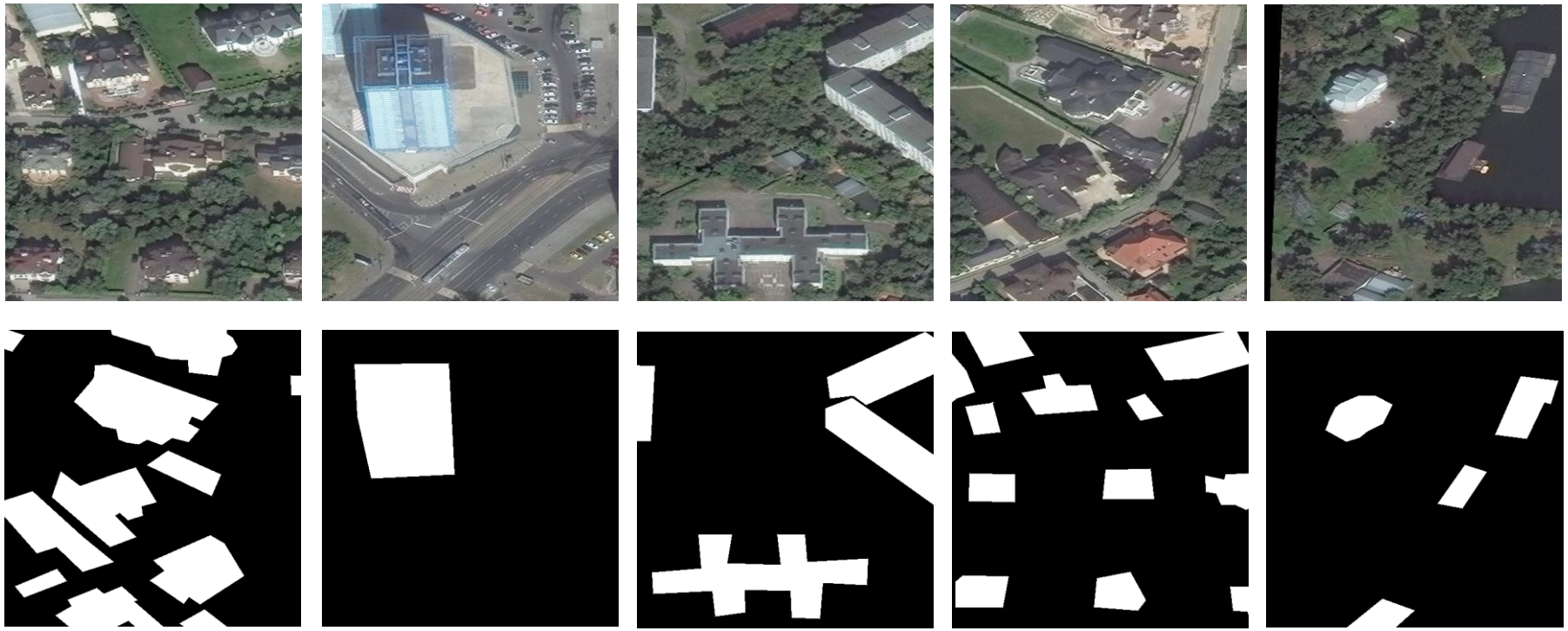
Planet database

- 14 samples in JPG format
- Resolution: 16384x16384 px, 0.5 m/pixel
- 3 Russian cities: Moscow, Yaroslavl, Rybinsk

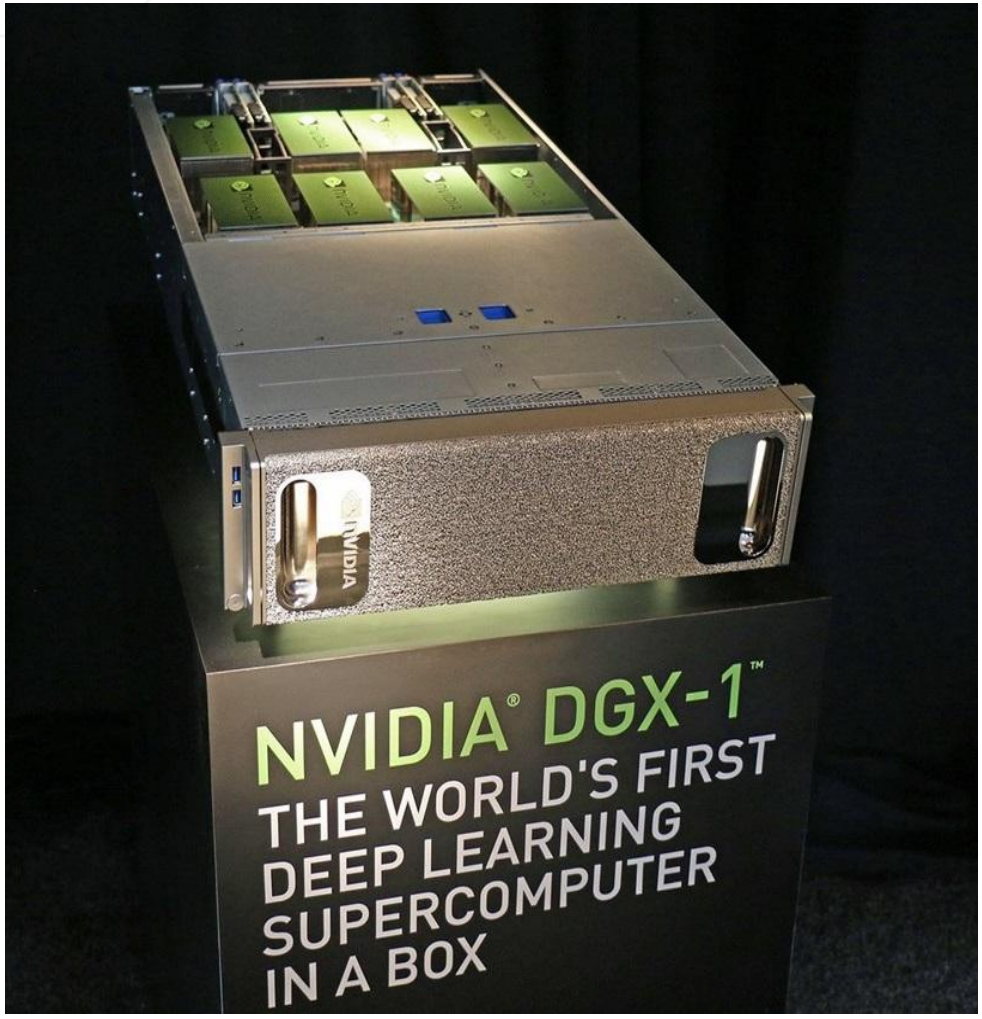


Dataset preparation

- 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 samples

Epochs (E): 96

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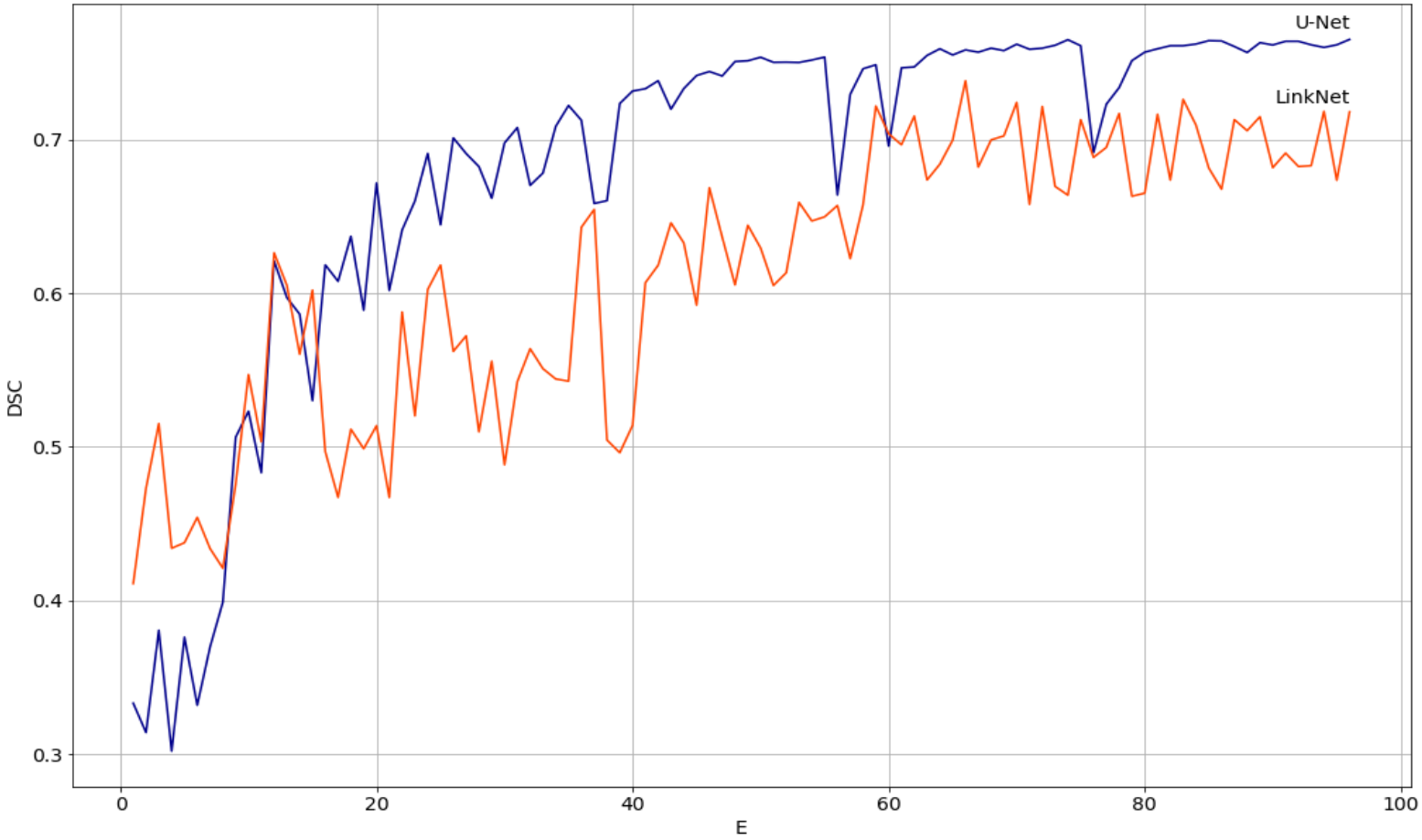
Numerical results

Model	Accuracy
U-Net	96.31%
LinkNet	95.85%

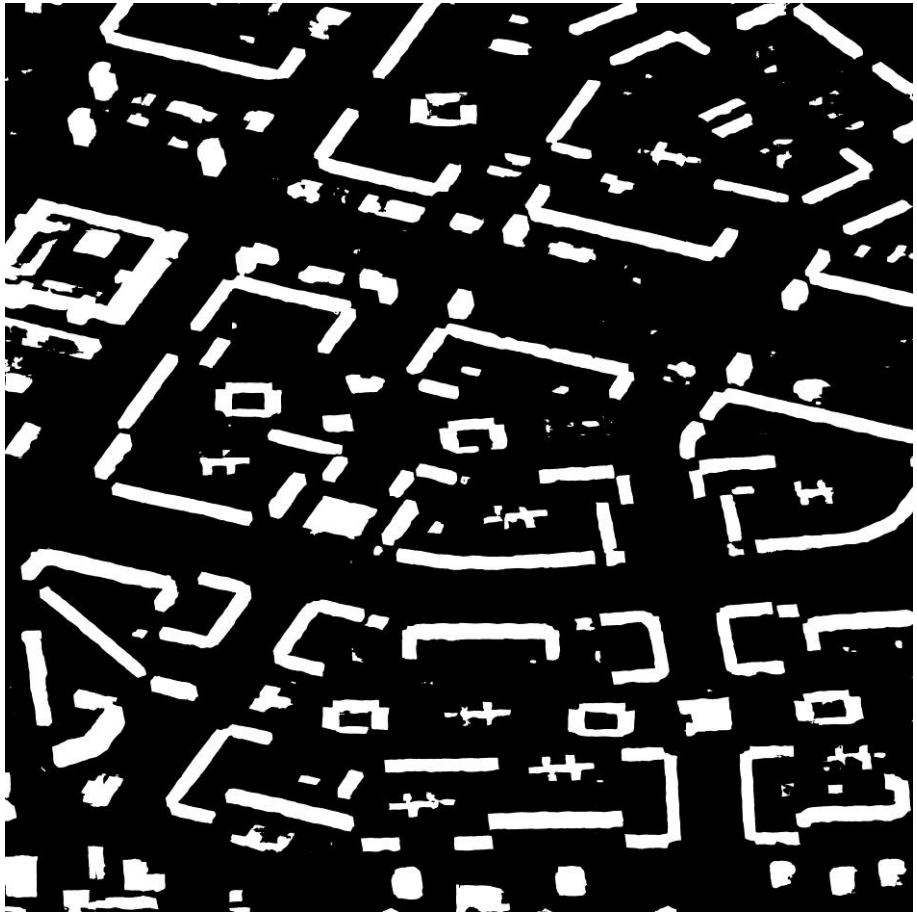
Model	Sorensen-Dice coefficient (DSC)
U-Net	0.77
LinkNet	0.72

Numerical results

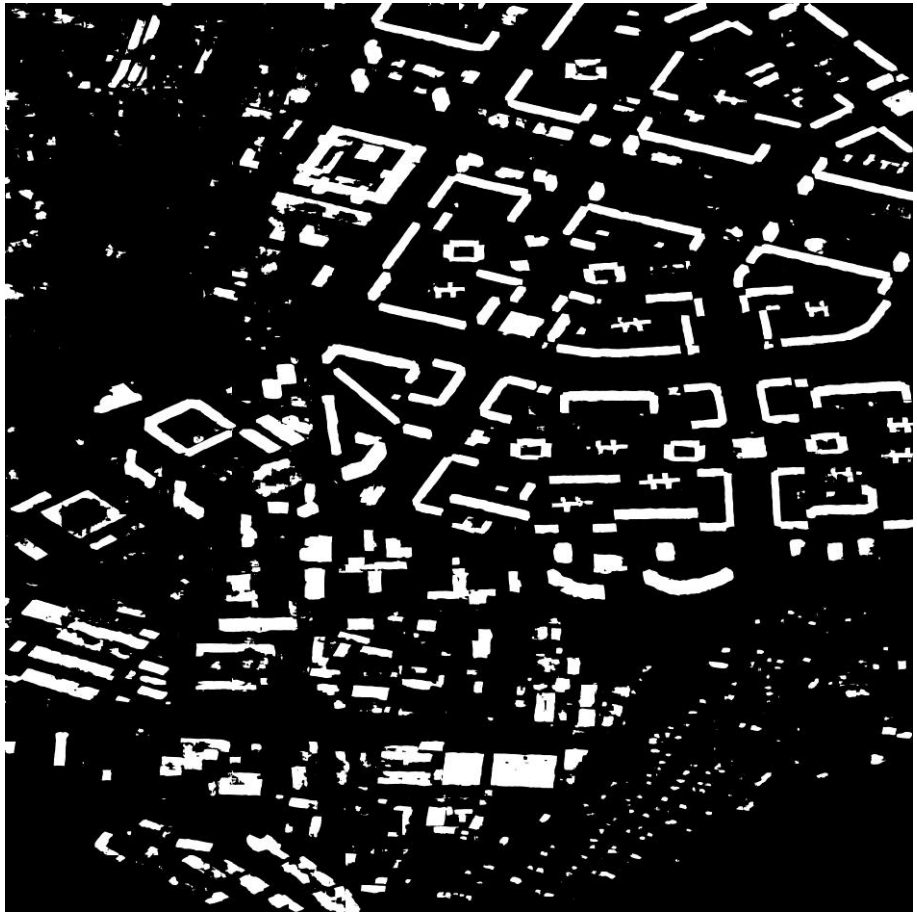
$$DSC = \frac{2I}{S}, \qquad I = \sum_{\substack{x \in X \\ y \in Y}} xy, \qquad S = \sum_{\substack{x \in X \\ y \in Y}} (x + y)$$



Examples of detection



Examples of detection



Conclusions

- Convolutional neural networks can be effectively used for building detection on aerial photos
- Dice similarity coefficient (DSC) shows the difference in application of various algorithms of deep learning
- The best performance was given by using U-Net

Acknowledgment

The work was prepared with the financial support of the Ministry of Education of the Russian Federation as part of the research project No. 14.575.21.0167 connected with the implementation of applied scientific research id. RFMEFI57517X0167

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OF THE RUSSIAN FEDERATION

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