1 слайд

Good afternoon! I am Leonid Ivanovsky and I want to tell you about “Building Detection on Aerial Images Using U-NET Neural Networks”

2 слайд

The problem of satellite images segmentation is challenging. Nowadays this problem is in the focus of research community. In machine learning, the segmentation is usually formulated as a pixel labeling task. So our task was to develop effective algorithm for building detection on satellite images based on deep convolutional neural network. The problem of building detection on satellite images can be put into practice for urban planning or building control.

3 слайд

Nowadays, in solving modern problems of computer vision, CNNs exceed traditional methods and work of experts. The usage of such methods instead of traditional approaches is non-trivial, because they should:

Take into account the small size of objects.

Be invariant to rotation.

Have enough training examples.

Handle huge images.

Cope with noise.

4 слайд

Now I’m going to present developed deep learning algorithms.

The first was U-Net. It consists of two parts: an encoder and a decoder. The encoder has the typical architecture of CNN and contains four blocks. Each of these blocks consists of two conv, 2 BN, 2 ReLU and 1 maxpooling. The decoder contains the same amount of blocks as an encoder. Every such block consists of upsampling, merging with the corresponding features map from an encoder, 2 conv, 2 BN and 2 ReLU. The last layer uses a 1x1 convolution to match each component vector to classes.

5 слайд

Also there was developed LinkNet- As U-Net, LinkNet has two parts: an encoder and a decoder. Both parts consist of 4 blocks. The scheme of encoder block is presented. A decoder block has the same structure, except maxpooling, which was exchanged to upsampling.

6 слайд

A database of images is the important part for learning, efficiency evaluation and comparative analysis of different machine learning algorithms. To research different developed networks for satellite image segmentation there was used Planet database.

Describe dataset

7 слайд

In spite of little amount of images, extracting methods allow to crop smaller images with resolution 512x512 px. As a result the training set contains 2611 photos and the test set contains 653 photos. Train and test samples did not have same pictures.

8 слайд

The launch of the CNNs was carried out on the supercomputer NVIDIA DGX-1 of Artificial Intelligence Center of P.G. Demidov Yaroslavl State University. As a numerical optimization algorithm, Adaptive Moment Estimation optimizer (Adam) was chosen. As a loss function, binary cross entropy function was used. On every training iteration the model updated its weights using the batch of 18 samples. The classifier ended its training after completing 96 epochs.

9 слайд

According to the first table, all algorithms show high value of accuracy. But the quality of algorithms for image segmentation is evaluated by special coefficients for comparing the similarity of predicted and true masks. To estimate developed models there was used Dice similarity coefficient. The results of DSCs for each developed network are presented in the second table.

10 слайд

This index is binary measure of similarity, possesses the value from [0, 1] and can be calculated by formulas on the top of this slide.

According to presented results the worst results were shown by LinkNet, while the best results were obtained using U-Net.

11-12 слайд

Here, some test results are presented.

13 слайд

To conclude it is claimed that CNNs can be efficiently used for building detection on aerial photos. Therefore, in this work U-Net and LinkNet were developed. To show the difference in application of various deep learning algorithms DSC was choosen. After training and testing developed models on supercomputer NVIDIA DGX-1, the best results were obtained by U-Net: the value of DSC was about 0.77. This model was put into practice and applied to real data from satellites.