# Yedrouj-Net: An efficient CNN for spatial steganalysis

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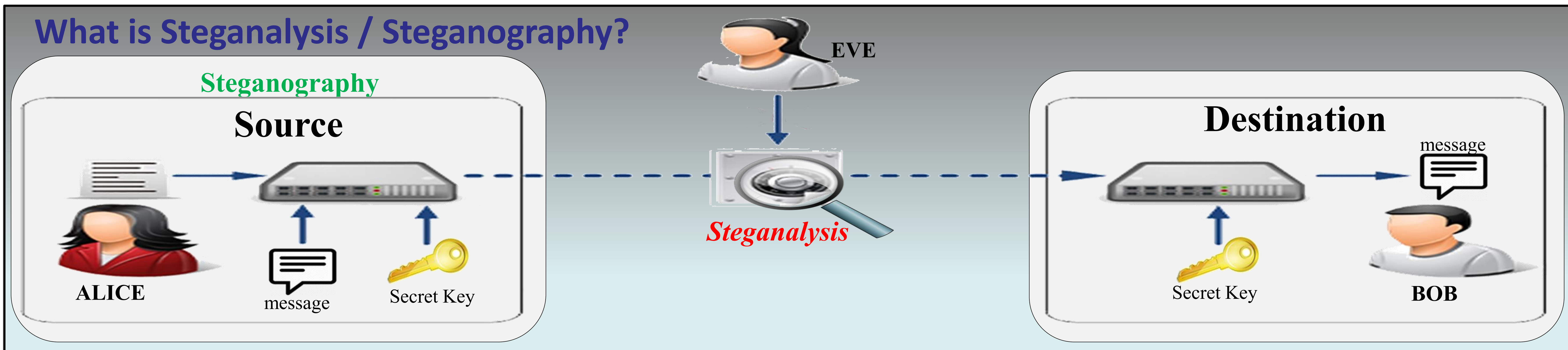
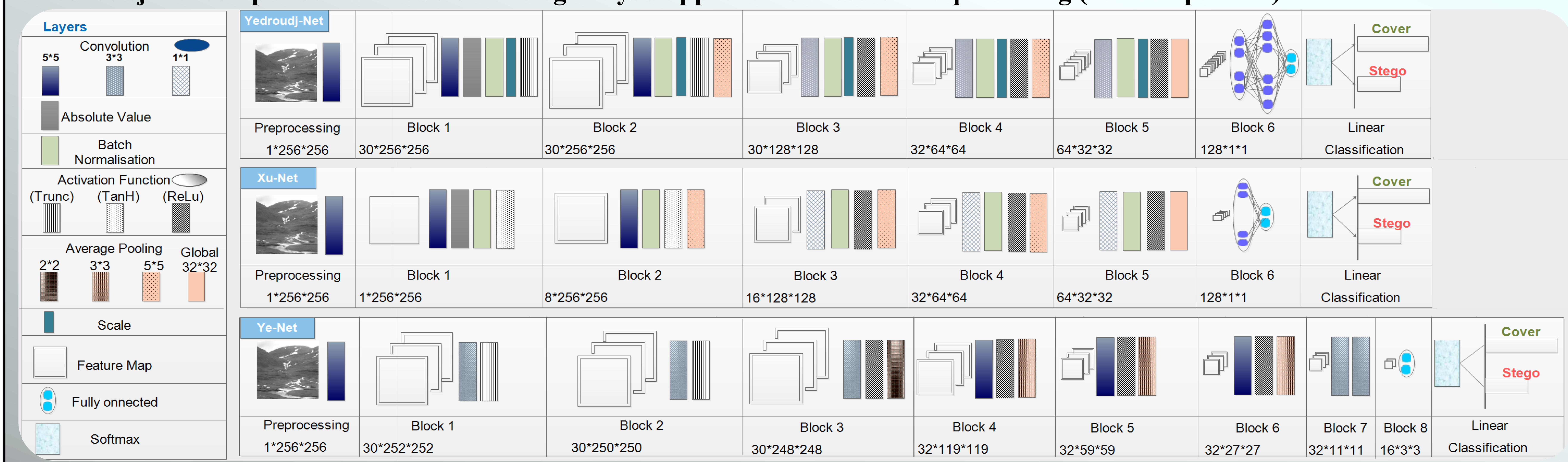
ICASSP 2018

## What is Steganalysis / Steganography?




## Proposed architecture

**Yedroudj-Net comparison with two other steganalysis approaches based on deep learning (fair comparison).**




Yedroudj-Net:

1. It has the advantage of using 30 SRM kernels which increases the diversity.
2. A shallow network compared to the Ye-Net equipped with a "value clipper" (hard tanh) activation function.
3. Thanks to batch normalization, Yedroudj-Net converges faster and is more robust with respect to hyperparameters.

## Results

### 1. *Clairvoyant protocol:*

- Resize the 10000 images of BOSSBase to 256*256.
- Use the two algorithms WOW and S-UNIWARD to generate the stegos.
- Select 1000 pairs from the training set for validation.
- Use the 5000 images of the test set to evaluate the obtained model.

**Comparison of Yedroudj-Net and three state-of-the-art steganalysis methods in terms of steganalysis probability of error.**

| | *BOSS 256×256* | | | |
|---|---|---|---|---|
| | **WOW** [6] | | **S-UNIWARD** [5] | |
| | 0.2 bpp | 0.4 bpp | 0.2 bpp | 0.4 bpp |
| SRM+EC [1], [2] | 36.5 % | 25.5 % | **36.6 %** | 24.7 % |
| Yedroudj-Net | **27.8 %** | **14.1 %** | **36.7 %** | **22.8 %** |
| Xu-Net [3] | 32.4 % | 20.7 % | 39.1 % | 27.2 % |
| Ye-Net [4] | 33.1 % | 23.2 % | 40.0 % | 31.2 % |

### 2. *Base augmentation protocol:*

- *Add 10 000 pairs of cover/stego of BOWS2Base to the training set (Clairvoyant protocol).*
- *Rotate and flip the 14000 images of the training set.*
- Use the 5000 images of the test set to evaluate the obtained model.

**Comparison of Yedroudj-Net's and two state-of-the-art steganalysis's probability of error against a steganographic algorithm WOW at a payload of 0.2 bit per pixel (bpp).**

| | *WOW 0.2 bpp* | | |
|---|---|---|---|
| | BOSS | BOSS+BOWS2 | BOSS+BOWS2+VA |
| Yedroudj-Net | **27.8** % | **23.7** % | **20.8** % |
| Ye-Net | 33.1 % | 26.1 % | 22.2 % |
| Xu-Net | 32.4 % | 30.3 % | 30.5 % |

## Conclusions

- An efficient approach based on deep learning (CNN) for steganalysis.
- Our method outperforms the state-of-the-art and others CNN-based models with and without taking extra measures (train set augmentation).
- Future work:
  1. Increase the size of the training set.
  2. Try other tricks such as transfer learning.
  3. Try an ensemble of Yedroudj-Nets.

## Related Work[7]

For an efficient database augmentation 2 options:

- Produce new images using the same cameras and development than the original base.
- Eve has an access to the original RAW images to use them for producing new images with similar developments.

## References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4. J. Ye, J. Ni and Y. Yi, "Deep Learning Hierarchical Representations for Image Steganalysis," in IEEE Transactions on Information Forensics and Security, vol. 12, no. 11, pp. 2545-2557, Nov. 2017.
5. V. Holub, J. Fridrich, and T. Denemark, "Universal Distortion Function for Steganography in an Arbitrary Domain," EURASIP Journal on Information Security, JIS, vol. 2014, no. 1, 2014.
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7. M.Yedroudj, M.Chaumont, F.Comby, "How to augment a small learning set for improving the performances of a CNN based steganalyzer?," MWSF'2018, Electronic Imaging2018, Burlingame, California, USA, 28 Jan - 2 Feb 2018.