The effect of image enhancement algorithms on convolutional neural networks

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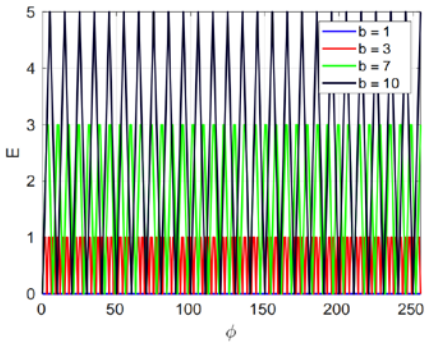
Methodology

Quantization Error



- Image brightness has an impact on the CNN performance
- Image rescale can be carried out introducing Bright Scale (b) as:

$$\hat{\phi} = \text{floor}\left(\tilde{\phi} + \frac{1}{2}\right) = \text{floor}\left(\frac{1}{b}\phi + \frac{1}{2}\right)$$

- A Quantization Error is produced:

$$E = \left|b \cdot \hat{\phi} - \phi\right| = \left|b \cdot \text{floor}\left(\frac{1}{b}\phi + \frac{1}{2}\right) - \phi\right|$$

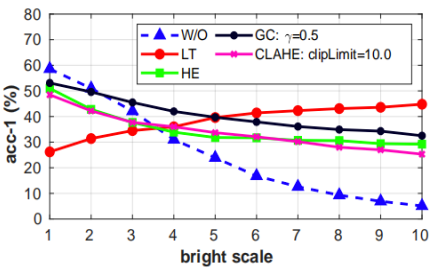
Experimental Results

- CNN performance is degraded as higher the bright scale (darker images)
- Four contrast enhancement algorithms have been used in the experiments: Gamma Correction (**GC**), Logarithm Transformation (**LT**), Histogram Equalization (**HE**) and Contrast-Limited Adaptive Histogram Equalization (**CLAHE**)
- Each Accuracy-1 point is calculated through 1000 images choosen randomly in the ILSVRC2012 Dataset

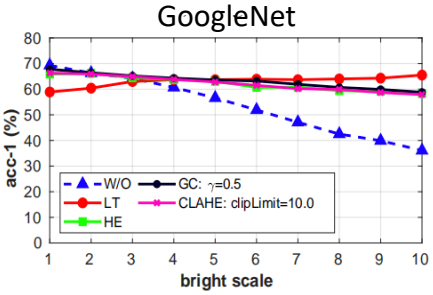
w/o algorithm

Logarithm Transformation

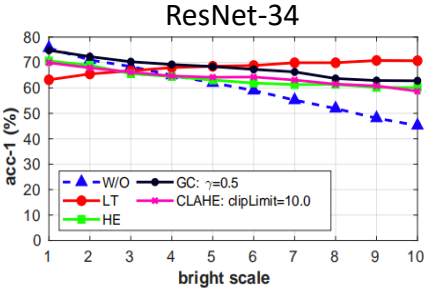
AlexNet



GoogleNet



ResNet-34



Conclusions

- It has been demonstrated the four contrast enhancement algorithms employed improve Accuracy-1 for AlexNet, GoogleNet and ResNet-34 for dark images
- Logarithm Transformation is the best algorithm for dark images but it presents some issues for brigther ones. The improvement is around 40% for a brigh scale (b) of 10
- The other algorithms are more robust to be used in a wider range of brightness (GC, HE and CLAHE)

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