Efficient Parameters for Rotation Processing of Data Augmentation

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<table>
<thead>
<tr>
<th>Name</th>
<th>Duke Maeda.</th>
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<tbody>
<tr>
<td>Affiliation</td>
<td>Tokai University Bachelor degree program.</td>
</tr>
<tr>
<td>Birth</td>
<td>17, Jan 2000</td>
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<tr>
<td>Interest</td>
<td>Language, Culture, AI</td>
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<tr>
<td>Language</td>
<td>English Japanese Arabic ..etc</td>
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<td>Culture</td>
<td>martial arts</td>
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<tr>
<td>AI</td>
<td>This technology can make society better.</td>
</tr>
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</table>
Problem

Huge amount of time to prepare
Prepare a large number of images

Solve

Data augmentation

Horizontal flipping
Rotation
Color jittering

Rotation

180°

180°
Rotation

Not lose object features

Lose object features
Previous research

Identified plant diseases ※1

Original

36-fold

※1: Y.Kawasaki et al, “Basic Study of Automated Diagnosis for Viral Plant Diseases with Convolutional Neural Networks”, 2015

<table>
<thead>
<tr>
<th>Augmentation Rate</th>
<th>Recognition Accuracy (%)</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>77.0</td>
</tr>
<tr>
<td>36</td>
<td>97.2</td>
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</tbody>
</table>
Previous research

Problem

How to rotate?

How to augment?
Purpose

Rotation Angle
- Not lose object features

Augmentation Rate
6 Lose object features
Experiment

Not lose object features
Experimental methods

Rotation Angle = 360° / Augmentation Rate

1x
0°

2x
0°
180°

3x
0°
120°

... 

10x
0°
36°
36°
Experimental methods

HEp-2 cell

Malaria-infected cell

Branches
Experimental methods

GoogLeNet

Initial Learning Rate  0.001
Max Epoch              100 Epoch
Step Size              30 Epoch

Step function

F-measure

\[ \frac{2 \times \text{Precision} \times \text{Recall}}{\text{Precision} + \text{Recall}} \]
Result and Discussion for HEP-2 cell

<table>
<thead>
<tr>
<th>F-measure (%)</th>
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<tbody>
<tr>
<td>58.9</td>
</tr>
<tr>
<td>73.6</td>
</tr>
<tr>
<td>81</td>
</tr>
<tr>
<td>83.8</td>
</tr>
<tr>
<td>87.1</td>
</tr>
<tr>
<td>82.7</td>
</tr>
<tr>
<td>81.5</td>
</tr>
<tr>
<td>85.9</td>
</tr>
<tr>
<td>87.9</td>
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<tr>
<td>85.9</td>
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</table>

F-measure (%)
Result and Discussion for Malaria-infected cell

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
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<tbody>
<tr>
<td>94.5</td>
<td>95.3</td>
<td>95.4</td>
<td>95.9</td>
<td>94.6</td>
<td>94.4</td>
<td>95.1</td>
<td>95.3</td>
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<td>95.4</td>
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F-measure (%)
Result and Discussion for Branches
Experiment

Lose object features
Problem
Experimental methods

Doubled

-15° [ ] +15°

Tripled

-15° 6 6 6 +15°
<table>
<thead>
<tr>
<th>Angle</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>5°</td>
<td>6</td>
</tr>
<tr>
<td>10°</td>
<td>6</td>
</tr>
<tr>
<td>15°</td>
<td>6</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>35°</td>
<td>6</td>
</tr>
</tbody>
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Experimental methods

**ImageNet**

**MNIST**
Result and Discussion for ImageNet
Result and Discussion for MNIST
Conclusion

Not lose object features

Lose object features