Motivations

- Strengthen algorithm accuracy to reduce false alarms and improve traveler safety
- Reduce processing time compared to the 3D CNN
- Speed-up the passenger screenings at the airport

Related studies

- Multi-View Convolutional Neural Networks (MVCNN)
  - 3D shape recognition (Su et al., 2015)
  - 3D shape retrieval from ShapeNet Core 55 (Savva et al., 2016)
  - Cancer screening (Geras et al., 2017)
- Pretrained CNN model
  - VGG-16 on ImageNet (Simonyan and Zisserman, 2015)

Data set

- Originally 1147 examples of full body scan images
  - 319 (28%) of “no threat” examples
  - 928 (81%) of “threat” examples
- Data augmentation using combinations of:
  - Shifting 20–100 pixels
  - Sharpening and brightening
- Final data sets:
  - Training set (801 original and 1035 augmented examples)
  - Development set (230 original examples)
  - Test set (116 original examples)

<table>
<thead>
<tr>
<th></th>
<th>Original “no threat”</th>
<th>Augmented “no threat”</th>
<th>Original “threat”</th>
<th>Augmented “threat”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training</td>
<td>83.3%</td>
<td>41.7%</td>
<td>35.3%</td>
<td>14.2%</td>
</tr>
<tr>
<td>Development</td>
<td>19.1%</td>
<td>80.9%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test</td>
<td>19.0%</td>
<td>81.0%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Hyperparameters tuning

- Numbers of FC layers
- Keep-prob in dropout
- Learning rate
- Numbers of epoch
- Mini-batch size

Learning curves

- Logistic Regression
  - $\hat{y} = 1$: threats
  - $\hat{y} = 0$: no threats

Predictions

<table>
<thead>
<tr>
<th>Evaluation</th>
<th>Fine-tuning MVCNN</th>
<th>Transfer learning MVCNN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training accuracy</td>
<td>99.7%</td>
<td>100%</td>
</tr>
<tr>
<td>Dev accuracy</td>
<td>97.8%</td>
<td>100%</td>
</tr>
<tr>
<td>Test accuracy</td>
<td>95.7%</td>
<td>99.3%</td>
</tr>
<tr>
<td>Test recall</td>
<td>98.9%</td>
<td>100%</td>
</tr>
<tr>
<td>Test precision</td>
<td>95.9%</td>
<td>98.9%</td>
</tr>
<tr>
<td>Test f1 score</td>
<td>97.4%</td>
<td>99.5%</td>
</tr>
</tbody>
</table>

The transfer learning is slightly better than fine-tuned MVCNN on this dataset.