An arthroscopy or "keyhole surgery" is a minimally invasive surgical procedure that enables a surgeon to examine and treat a joint by inserting an arthroscope, a pencil-sized instrument equipped with a miniature camera. Worldwide, over 2 million arthroscopy videos are recorded annually. Our goal is to lessen the workload of the surgeons by assisting their task of video summarization/annotation of arthroscopic video feeds.

ArthroScout is a tool classification software that utilizes image processing and machine learning methods (specifically convolutional neural networks or CNNs) to detect and classify the types of tools used in the arthroscopic surgery.

### Dataset
- 3 data sets: 360,000 training, 6,000 validation, and 1,200 testing images
- 5 image augmentations: brightness, contrast, jpeg compression, motion blur, and color transfer

Classes from left to right: Heat Wand, Basket Biter, Suture (top)
Probes, Shaver, and No Tool (bottom)

### CNN Architecture

24-Convolutional Layer Network Architecture:
- Batch normalization after each convolutional layer
- Average pooling at every 3 convolutional layers
- Xavier Initialization
- 1.97M trainable parameters
- Residual blocks

### Test Accuracy

<table>
<thead>
<tr>
<th>Class</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basket Biter</td>
<td>0.780</td>
</tr>
<tr>
<td>Heat Wand</td>
<td>0.810</td>
</tr>
<tr>
<td>Probe</td>
<td>0.940</td>
</tr>
<tr>
<td>Shaver</td>
<td>0.755</td>
</tr>
<tr>
<td>Suture</td>
<td>0.875</td>
</tr>
<tr>
<td>No Tool</td>
<td>0.955</td>
</tr>
</tbody>
</table>

Average Accuracy: 0.853

### Timing Analysis:
- 29.73 frames per second
- Near Real-Time