Encoding Natural Scenes with Neural Circuits with Random Thresholds *
List of Supplementary Materials

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The supplementary material consists of a total of six videos. The original video was a supplementary material in [1], which was taken by a high speed camera at 6000 fps. We took the first 120 frames (0.2 ms), cropped the video in 48 by 48 pixels to highlight the body of the fly and interpolated spatially to 96 by 96 pixels. Temporally, each pixel was filtered by a lowpass filter bandlimited to 200 Hz to achieve better numerical integration accuracy and limit the number of spikes.

1. **Supplementary video 1:**
   Reconstruction of the fly video encoded with ideal IAF neurons with deterministic thresholds.
   The three videos are (from left to right): original video, reconstructed video and the error, respectively. SNR of this video is 27.5dB, and SSIM on average is 0.9634.

2. **Supplementary video 2:**
   Reconstruction of the fly video encoded with ideal IAF neurons with random thresholds of Gaussian distribution, with threshold variability of 1%.
   The three videos are (from left to right): original video, reconstructed video and the error, respectively. SNR of this video is 25.8dB, and SSIM on average is 0.9308.

3. **Supplementary video 3:**
   Reconstruction of the fly video encoded with ideal IAF neurons with random thresholds of Gaussian distribution, with threshold variability of 2.5%.
   The three videos are (from left to right): original video, reconstructed video and the error, respectively. SNR of this video is 21.3dB, and SSIM on average is 0.8024.

4. **Supplementary video 4:**
   Reconstruction of the fly video encoded with ideal IAF neurons with random thresholds of Gamma distribution, with threshold variability of 1%.
   The three videos are (from left to right): original video, reconstructed video and the error, respectively. SNR of this video is 25.8dB, and SSIM on average is 0.9299.

5. **Supplementary video 5:**
   Reconstruction of the fly video encoded with ideal IAF neurons with random thresholds of Gamma distribution, with threshold variability of 2.5%.
   The three videos are (from left to right): original video, reconstructed video and the error, respectively. SNR of this video is 21.3dB, and SSIM on average is 0.7991.

6. **Supplementary video 6:**
   The 2D spectrums of the error in video 1, 2 and 3, respectively, from left to right. The boundary of 3 pixels on the four edges were cut off before computing the 2D FFT.

References

[1] Dickinson M. Card, G. Performance trade-offs in the flight initiation of Drosophila . *Journal of Experimental Biology*, 211:341–353, 2008.