DNA Nunchucks: Nano-Instrumentation for Single-Molecule Measurement of Stiffness and Bending

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Read the paper
Xinyue Cai et al Nano Letters 2019
DNA “nunchuck”: a self-assembled DNA molecule

DNA origami “seed”

dsDNA “linker”

DNA nanotube

SEs tile

REs tile

Cy3 fluorophore

Atto488 fluorophore

Imaging rate: 0.33 Hz
Analyzing for nunchuck bend angles with a neural network

Confusion matrix of the neural network recovering bend angles from 7,200 test images:

Sample result of the neural network on real data:

The bend angle, $\theta$
Calibrating the nunchuck for measuring intrinsic stiffness and bending

**Nunchuck flexibility vs linker length**

- **in phase seeds**
- **intermediate phase seeds**
- **out of phase seeds**
- **out of phase seeds with A6-tracts**

\[
\begin{align*}
L_p &= 131 \pm 33 \text{ bp} \\
l_0 &= 10 \pm 11 \text{ bp}
\end{align*}
\]

\[
\begin{align*}
L'_p &= 229 \pm 13 \text{ bp} \\
l'_0 &= l_0
\end{align*}
\]

**Nunchuck mean bend angle vs the number of intrinsically bent A6-tracts**

\[\alpha = 17 \pm 1^\circ\]
For work in progress, visit my talk (2:40pm, Mon 9 Nov)
“Dynamic, Single-Molecule Measurements of Intrinsic and Induced Nucleic Acid Bending Using DNA Nanostructures and Video Microscopy”

Flexibility and bend of structural defects:

- Bubble:
- Bulge:

Protein-induced DNA bending

Integration-host factor (IHF)