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Single-Molecule Encoders for Tracking Motor Proteins on DNA

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Devices such as inkjet printers and disk drives track position and velocity using optical encoders, which produce periodic signals precisely synchronized with linear or rotational motion. We have implemented this technique at the nanometer scale by labeling DNA with regularly spaced fluorescent dyes. The resulting molecular encoders can be used in several ways for high-resolution continuous tracking of individual motor proteins. These measurements do not require mechanical coupling to macroscopic instrumentation, are automatically calibrated by the underlying structure of DNA, and depend on signal periodicity rather than absolute level. I will describe the synthesis of single-molecule encoders, data from and modeling of experiments on a helicase and a DNA polymerase, and some ideas for future work.