Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Phototactic guidance of a tissue-engineered soft-robotic ray. SUNG-JIN PARK, Harvard University, MATTIA GAZZOLA, University of Illinois at Urbana-Champaign, KYUNG SOO PARK, University of Michigan, SHIRLEY PARK, Stanford University, VALENTINA DI SANTO, Harvard University, KARL DEISSEROTH, Stanford University, GEORGE V. LAUDER, L. MAHADEVAN, KEVIN KIT PARKER, Harvard University — Inspired by the relatively simple morphological blueprint provided by batoid fish such as stingrays and skates, we created a biohybrid system that enables an artificial animal, a tissue-engineered ray - to swim and phototactically follow a light cue. By patterning dissociated rat cardiomyocytes on an elastomeric body enclosing a microfabricated gold skeleton, we replicated fish morphology at 1/10 scale and captured basic fin deflection patterns of batoid fish. Optogenetics allows for phototactic guidance, steering, and turning maneuvers. Optical stimulation induced sequential muscle activation via serpentine-patterned muscle circuits, leading to coordinated undulatory swimming. The speed and direction of the ray was controlled by modulating light frequency and by independently eliciting right and left fins, allowing the biohybrid machine to maneuver through an obstacle course.

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Date submitted: 29 Jul 2016 Electronic form version 1.4