

FLOW

fluid form generation from gestural sculpting

Course #: A48-724

Location: CFA 317

Instructors: Joshua Bard, jdbard@cmu.edu

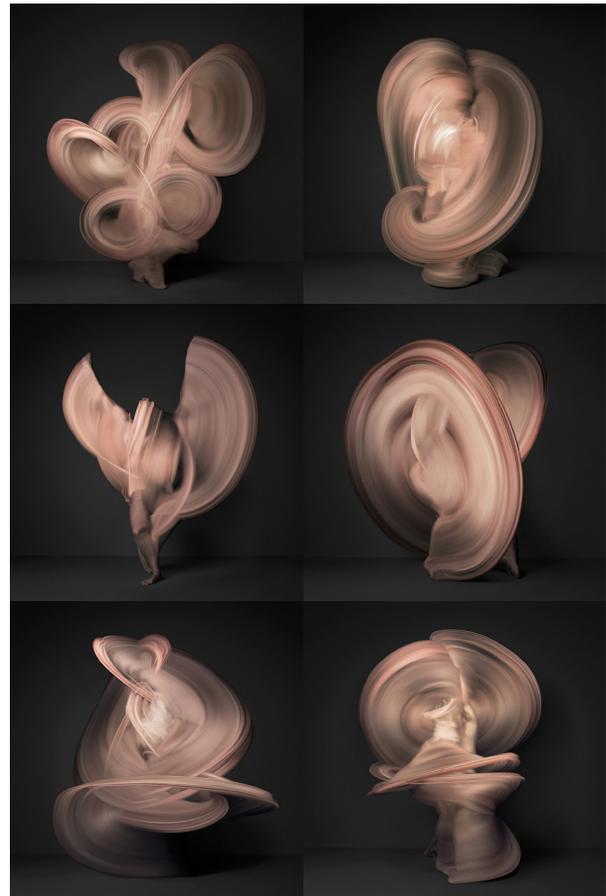
Ramesh Krishnamurti, ramesh@cmu.edu

Office: MMH 310b, MMH 412c

Technology has long augmented our experience and understanding of a world in constant flux. One need only think back to the sensational effect of Eadweard Muybridge's motion studies using early photographic techniques (e.g. Horse in Motion) where humans were able to see phenomena never before accessible to the naked eye. Recent developments in computer vision (CV) not only extend our visual range but also enable precise positional tracking in 3D space. One example is the MOCAP (motion capture) system recently installed in the SoArch dFab Lab. This system provides precise location (x,y,z) and orientation (roll, pitch, yaw) tracking at 120 frames/second with sub-millimeter accuracy. *Flow: fluid form generation and gestural sculpting* asks you to harness the creative potential of this technology by developing scripted workflows to explore the movement of objects through space.

Design Problem Develop and test a scripted workflow for generating rapid prototype models (3D printing) from gestural inputs tracked using a commercial Motion Capture System (MOCAP).

Develop Tracking Objectile Design and fabricate an object that can be tracked using the lab's MOCAP system. Careful attention should be paid to how this object will/can move within the constraints of the MOCAP field-of-view. The physical makeup of the object should encourage a specific range of motion. For example if my tracking objectile were a tennis ball, I would get



Nude, Shinichi Maruyama

drastically different results by tossing the ball in the air, bouncing it off a wall, or swinging it around on a string.

Define/Track Rigid Body Objects are tracked in a MOCAP system by reflecting infrared light back to an array of cameras. Small infrared reflectors are attached to objects in asymmetrical arrays to bounce back IR light and provide Rigid Body location and orientation. A minimum of three IR dots are used to track each Rigid Body in a motion capture scene. Refer to the dFab Wiki [MOCAP Tutorial](#) for a detailed description of defining and tracking rigid bodies.

Stream Tracking Data position output can be streamed as raw data (x,y,z,rx,ry,rz). This data can be used to visualize motion and update digital models in real time. You will need to write a python component to listen for and parse incoming data.

Instantiate Primitive Once you have MOCAP data streaming into Grasshopper, begin to instantiate digital forms onto the motion path. These forms should be of your own design (they do not have to look like the object you tracked) and should respond to / reflect the qualities of the motion each form is mapped onto. Custom python components should be used to gain parametric control of this process. For example an object may vary based on changes in acceleration, orientation, or inflection of the motion path.

Physical Prototype Once you have refined your approach and tested initial results, select three models to be 3D printed. If you are unfamiliar with the 3D printing process, see the Rhino help section on STL prep and the [dFab Website](#) for printing guidelines.

Learning Objectives

- Students can translate physical sensing output into meaningful digital datasets.
- Students can stream and parse data in real-time using custom components in Grasshopper.
- Students can generate geometric parameters through data analysis using custom components in Grasshopper.

Deliverables

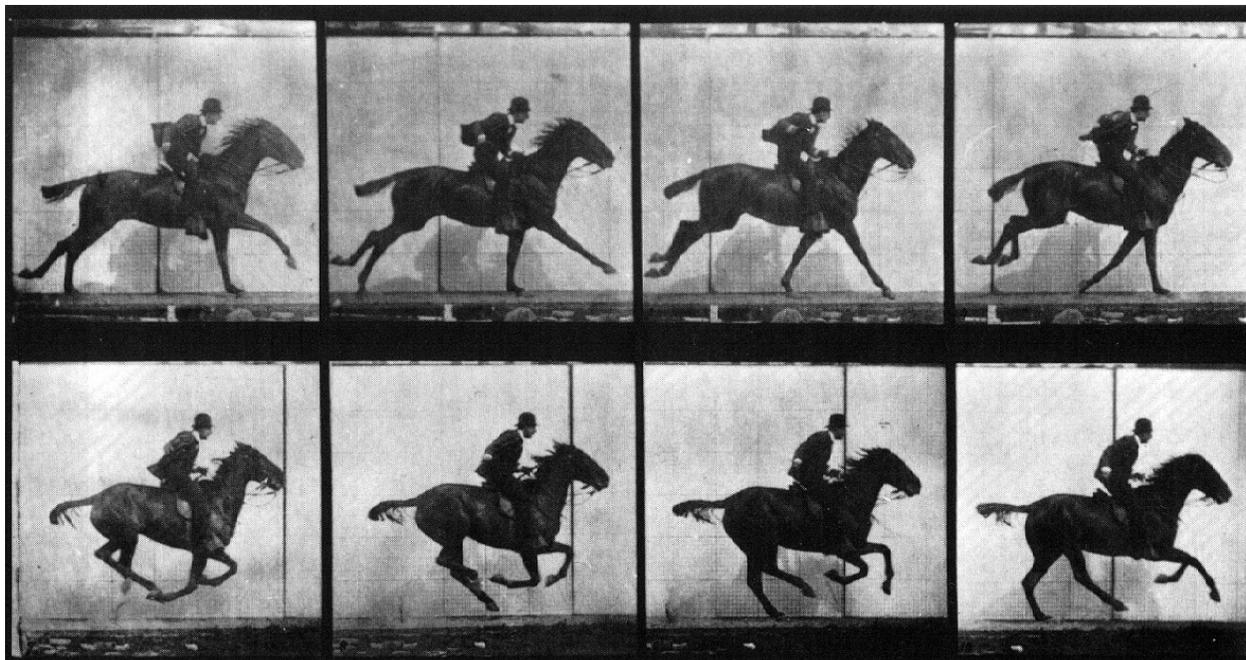
3D Print Models
Process Drawings / Video
Source files and scripts
All materials submitted to course [Wiki](#)

Resources

[dFab Website](#)
[dFab Wiki](#)
[OptiTrack Website](#)

Schedule

03.20 Project release, Lab: Intro to MOCAP
03.27 Lab: Live point tracking in GH
04.03 Work session (in dFab)
04.10 Carnival, No Classes
04.17 Test tracking due, Lab: Motion analysis
04.24 Test prints due, Work Session (in dFab)
05.01 Review final project, All deliverables due



Eadweard Muybridge, Horse in Motion, 1877

Sample Workflow

See the diagram below for a sample workflow for translating track motion into printable geometry. Custom GH components in Python should be used to customize and automate this process. Note: actual project workflow will likely be less linear and require looping back through earlier steps to refine the process.

dFab Wiki

All students should register on the dFab Wiki. Follow this [link](#) to register with a username (your Andrew ID) and your email address. Ignore the error you receive and expect an email from the wiki administrator with your updated credentials and password.

