Perception and Action

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BSc in Cognitive Science
Fall 2022

Kinematics Lab – Day 1: Measurement

Utley, A. (2019), Chapter 3: *Measurement and assessment in motor control:* In: *Motor control, learning and development: Instant notes* (Second edition). Routledge.

Ansuini, C., Giosa, L., Turella, L., Altoè, G., & Castiello, U. (2008). An object for an action, the same object for other actions: Effects on hand shaping. *Experimental Brain Research*, *185*(1), 111–119. https://doi.org/10.1007/s00221-007-1136-4

Today's topics

- General on motion tracking
- Transforming Ansuini et al. into our demo study
- Data collection of one very small and one proper demo

Today's schedule

8:15 – 8:45	Lecture: Introduction to the lab, equipment, and motion capture
9:00 – 13.00	Motion lab with Cordula & Sille; Group-work with Laura

9:00	Group 1
9:30	Group 2
10:00	Group 3
10:30	Group 4
11:00	Group 5
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12:00	Group 7
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13:00	Group 9 (?)

Best not to even bring any rings, watches, wristbands etc. – Nothing shiny!

Also: No food or drinks

Behave carefully and considerate, esp. given the small space

Read the exercise instructions before coming to the lab

13:30 – 14:00	Classroom: Wrap-up

The value of general (marker-based or marker-less) motion tracking

Motion tracking refers to all kinds of techniques to record dynamic behavior in space.

Why use motion tracking?

- Measure very small cues hidden in actions, e.g. about the underlying intention
- Quantify various performance parameters that are hidden in e.g. RT measures
- Precise analyses of movements, e.g. in sports sciences, training, and rehabilitation research
- Measure task-specific deviations from ‘typical’ performance
- Allow online control of experimental procedure based on action performance
- Use more realistic action tasks (in contrast to virtual movements etc.)
- Control that no movements happened, e.g. in infant research
- Detect early neuropsychological problems, e.g. in Autism

Deciding on measurement technique(s)

Decisions to make:

- Which parts of the body (single limbs, a finger, an arm, the whole body)
- What spatial coverage (one or multiple sensors, placement of sensors)
- What technology (optical, magnetic, gravity-based), what gets measured (position, orientation, acceleration …)
- What temporal and spatial resolution (high, low)
- How prone to occlusions and other noise
- How to ensure participants' comfort and safety (wearable, not disturb natural body movements and task performance)
- How portable (stationary systems, more flexible systems, or simple devices like mobile phones)
- Many more practical aspects: price range and availability, software availability, ease of use, room requirements etc.

Tracking systems

Specific movement tracking devices

OptoTrac, Vicon, Qualisys

Polhemus

Video camera based

Sensor types

Sensors (w/o cables)

Body suits

Sensor gloves

Commercial performance trackers

Wearable sensors (google watch etc.)

Objects with built-in sensors (mobile phones)

Gaming technology (often sensor-less)

Kinect, Wii

Virtual Reality

Motion data usually require preprocessing; afterwards they can be treated like any other data.

Tracking systems: Magnetic sensors

How does it work?

Source creates light magnetic environment

Sensors detect distortions due to movement

Advantages

Not so sensitive to occlusions

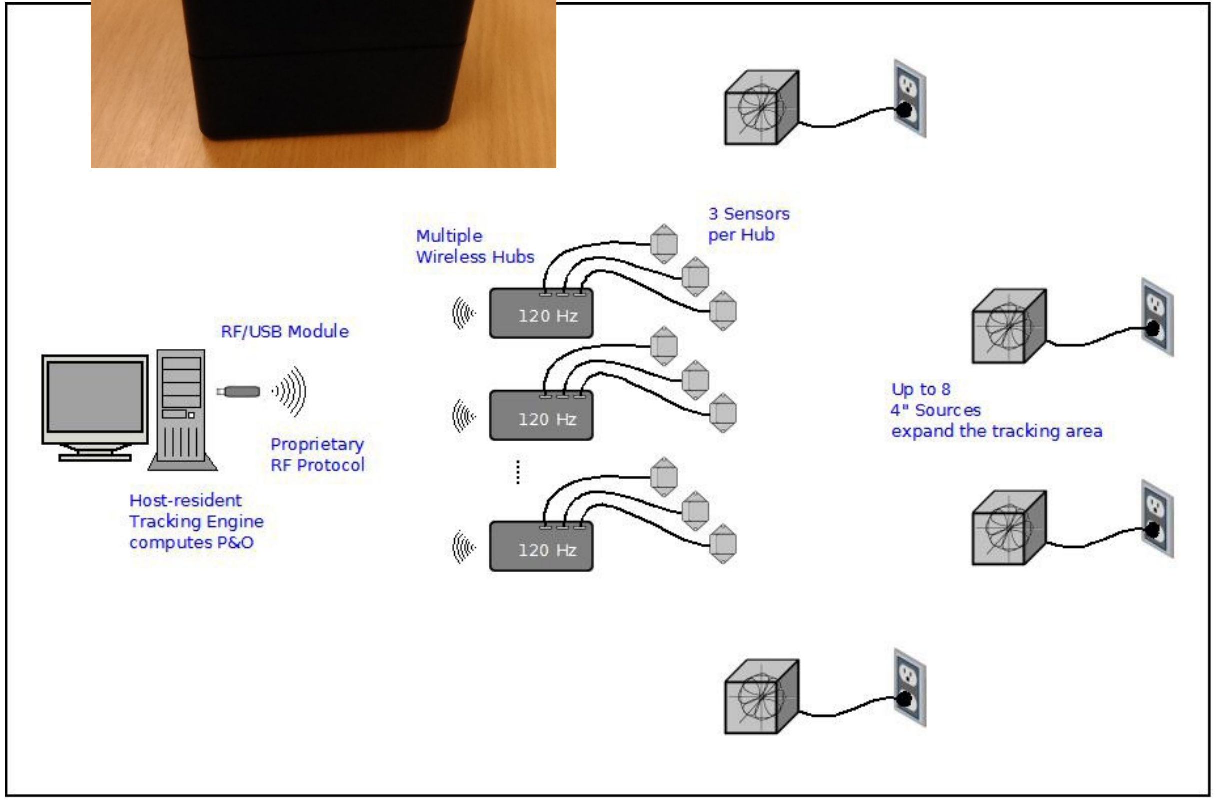
Flexible setup, portable

Disadvantages

Requires shielded environment

Difficult to combine with other methods, e.g. EEG

Example: Polhemus G4 system



Tracking systems: Optical sensors

How does it work?

Active or passive sensors are picked up with a system of cameras

Common advantages

Stable signal

Large coverage

Common disadvantages

Prone to occlusions, requires many cameras

Normally requires fixed setup

Other systems, e.g. Microsoft Kinect

Calibration procedure to detect joints → extracts skeleton based on movement contingencies: no sensors required

Example: Vicon system

Tracking systems: Accelerometers

How does it work?

Inertia-based, measures force against gravity

Advantages

Position independent

Often easy to set up

Disadvantages

Does not inform about absolute spatial position

Examples

Smart watches

Mobile phones

Specialized equipment, e.g. Swimtag

Example: Swimtag

The IMC Motion Lab

MoTEC lab

(Motion Tracking for Embodied Cognition)

Room 1483-433

Access with keycard

Funding by:

It-vest samarbejdende universiteter

Optical motion tracking: Qualisys Miqus

www.qualisys.com

Optical marker-based tracking

8 Miqus M3 infrared cameras

1 synchronized Miqus video camera

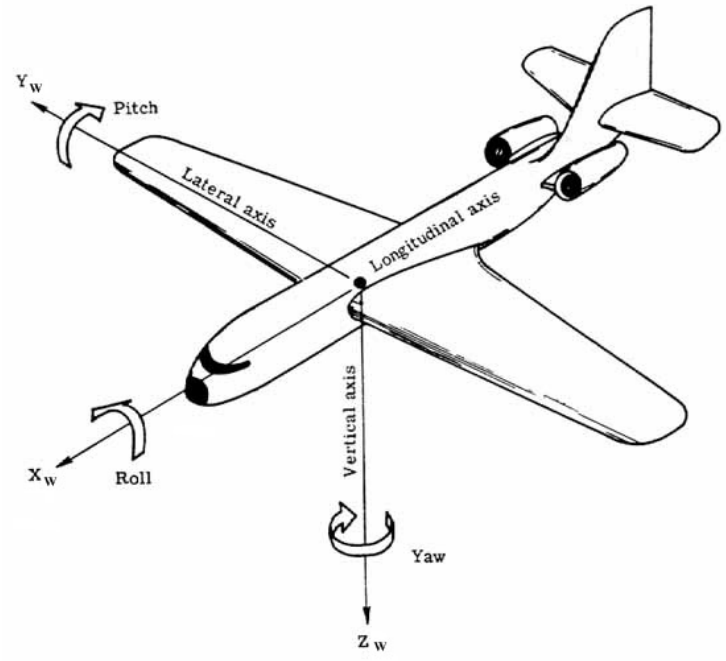
Passive, reflective markers

Constant sample rate of 100 Hz

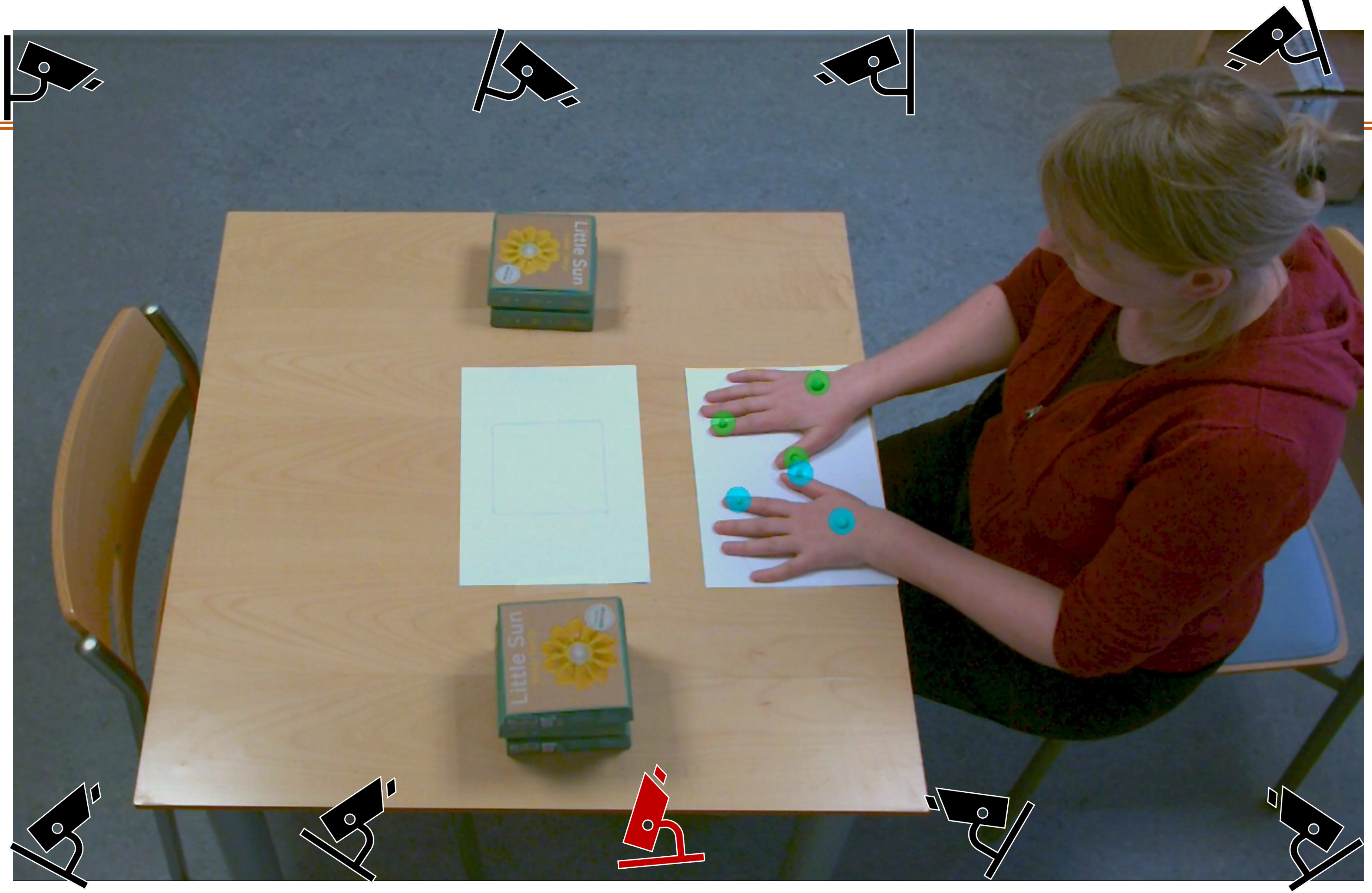
Tracking of many markers possible

QUALISYS

6 degrees of freedom



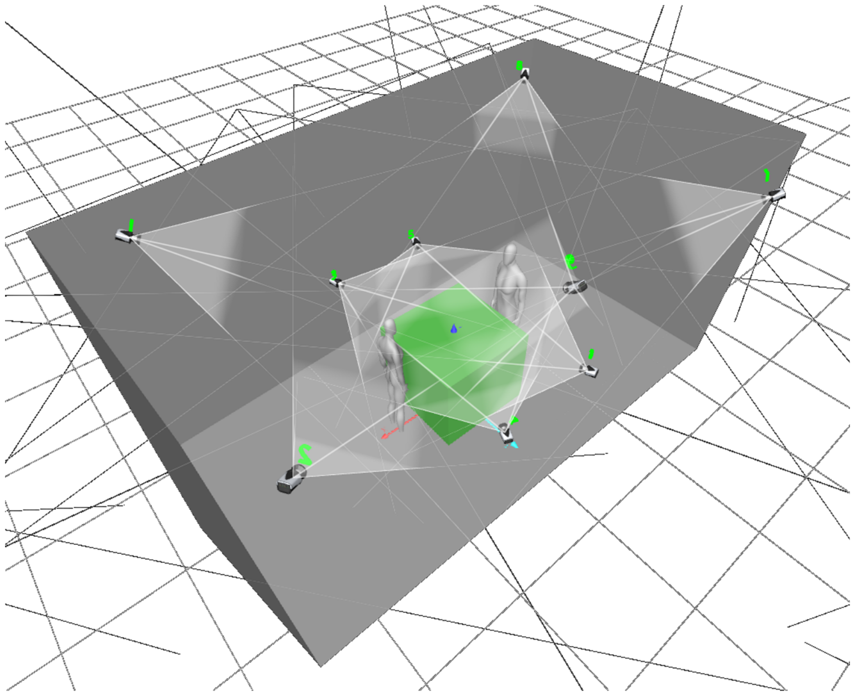
19 mm | 16 mm | 14 mm | 12.5 mm | 9.5 mm | 8 mm | 6.5 mm


Little Sun
Little Sun

How difficult is it to measure movement at IMC Motion Lab?

Easy ☺

- Full setup with computer, software, cameras, markers etc.
- Quite intuitive software package: Qualysis Track Manager (QTM)
- Ready-made arrangement of cameras in the IMC Motion Lab
- Intuitive measures



Challenging ☹

- Requires thorough planning, testing and learning new techniques
- Risk of data loss or marker switching
- Analysis and interpretation of movement not always trivial
- Requires really good experiment designs

Navigating today's lab visit

Qualisys Track Manager (QTM)

Matlab for streaming and experiment control

Automatic Identification of Markers (AIM) models

Many prepations done already

Transforming Ansuini et al. into our demo study

“The aim of the present study was to investigate whether the prior-to-contact grasping kinematics of the same object vary as a result of diVerent goals of the person grasping it.” (Ansuini et al., 2008, p. 111)

Conditions

(1) **Grasp** it without performing any subsequent action

(2) Lift and **throw** it

(3) **Pour** the water into a container

(4) **Place** it accurately on a target area

(5) **Pass** it to another person

Our variables:

MovementOnset, reachDuration, peakReachVelocity, maxReachHeight, maxReachAperture, graspHeight

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