CAPTURING OF MOVEMENT DURING MUSIC PERFORMANCE

BACHELOR THESIS

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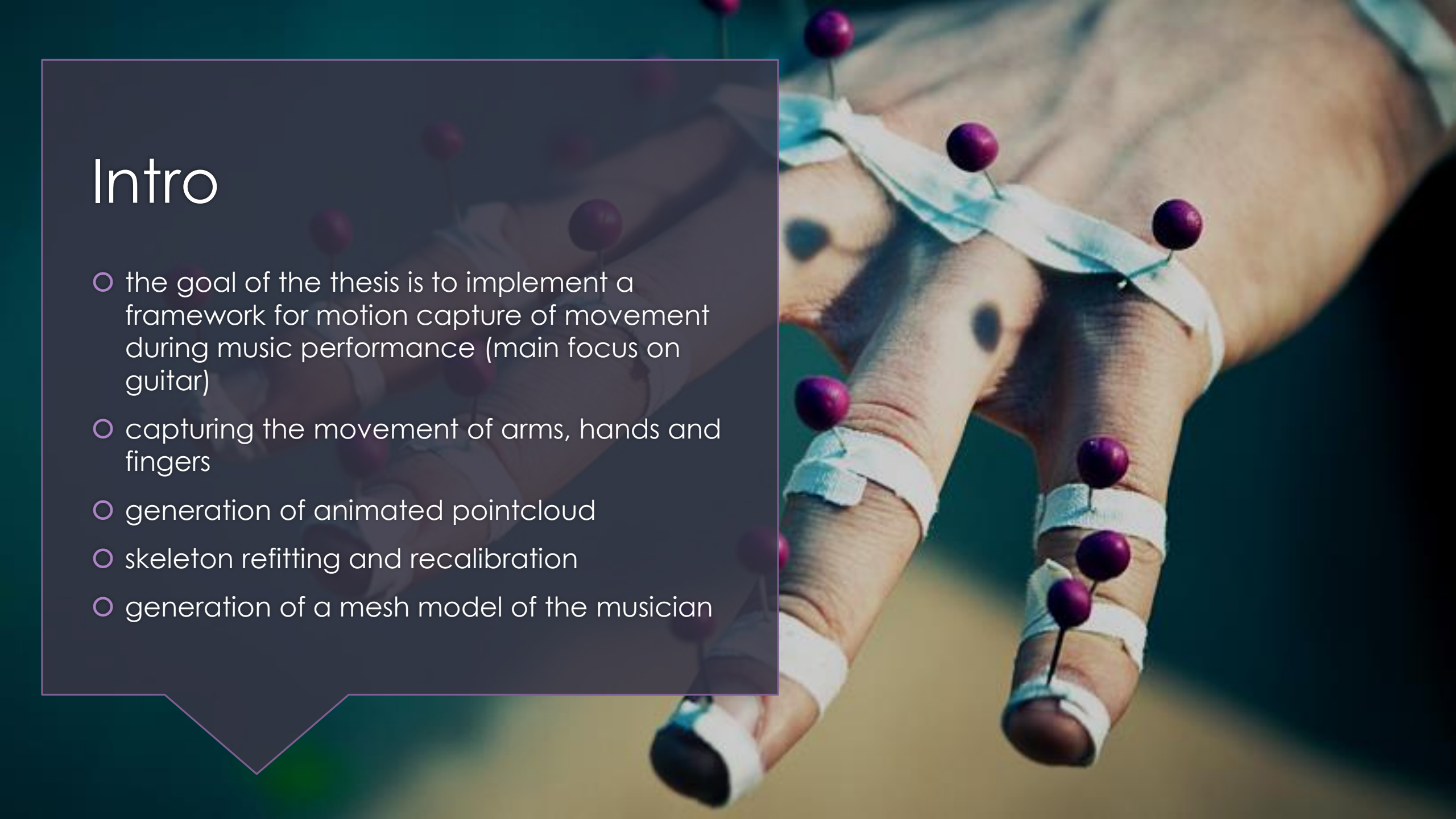
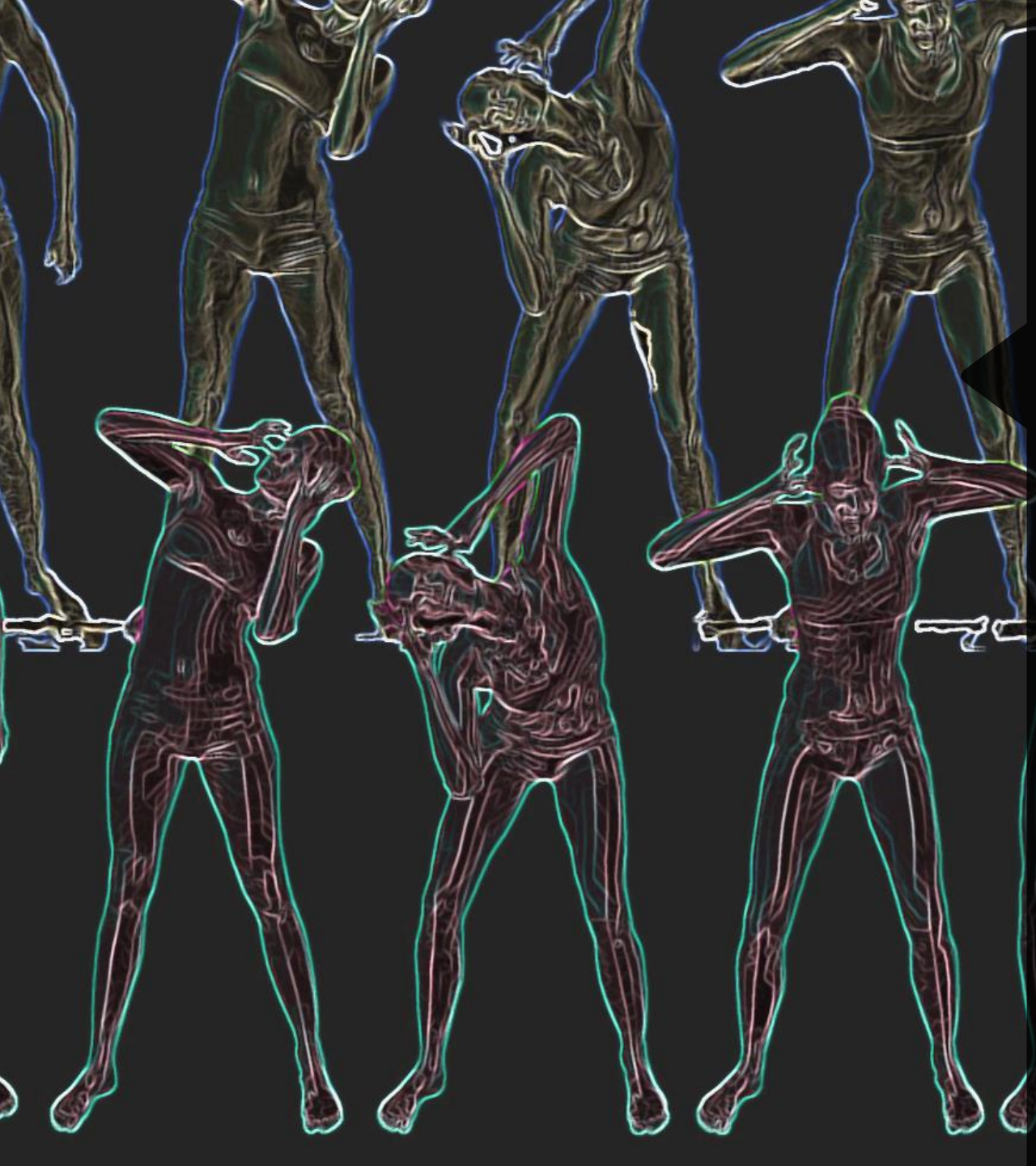
Intro

- the goal of the thesis is to implement a framework for motion capture of movement during music performance (main focus on guitar)
- capturing the movement of arms, hands and fingers
- generation of animated pointcloud
- skeleton refitting and recalibration
- generation of a mesh model of the musician



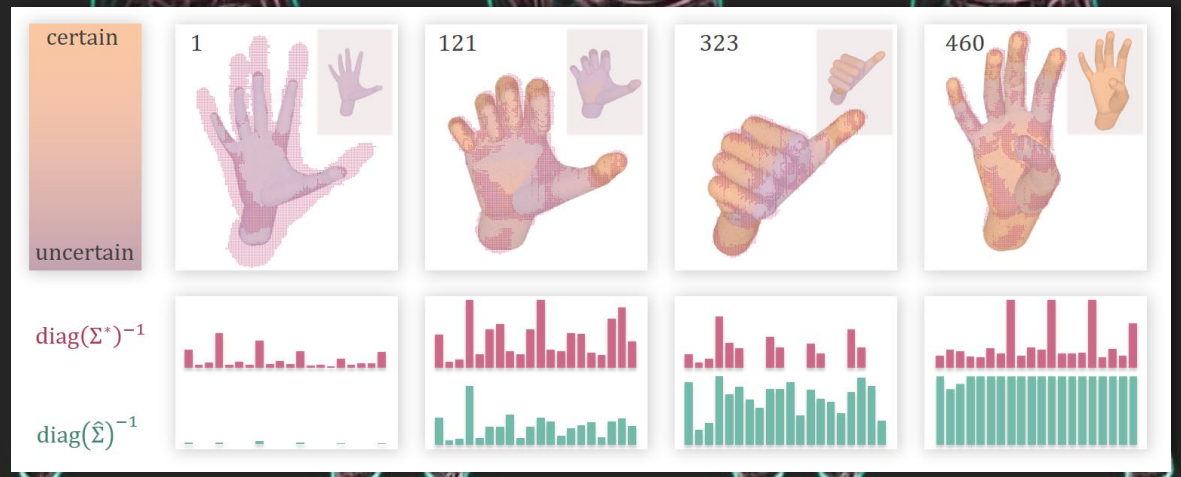
Equipment

- inertial-based motion capture suit
- Gloves (Synertial)
- RGB-D camera



Latest research

- Embodied Hands: Modeling and Capturing Hands and Bodies Together
  SIGGRAPH Asia 2017
  - realistic coordinated activity of body and hands movement
  - hands and bodies captured together
  - hand movement occlusion, low-resolution → **MANO** (hand Model with Articulated and Non-rigid defOrmations)
    - learned from 1000 high-resolution 3D scans of hands of 31 subjects in a wide variety of hand poses

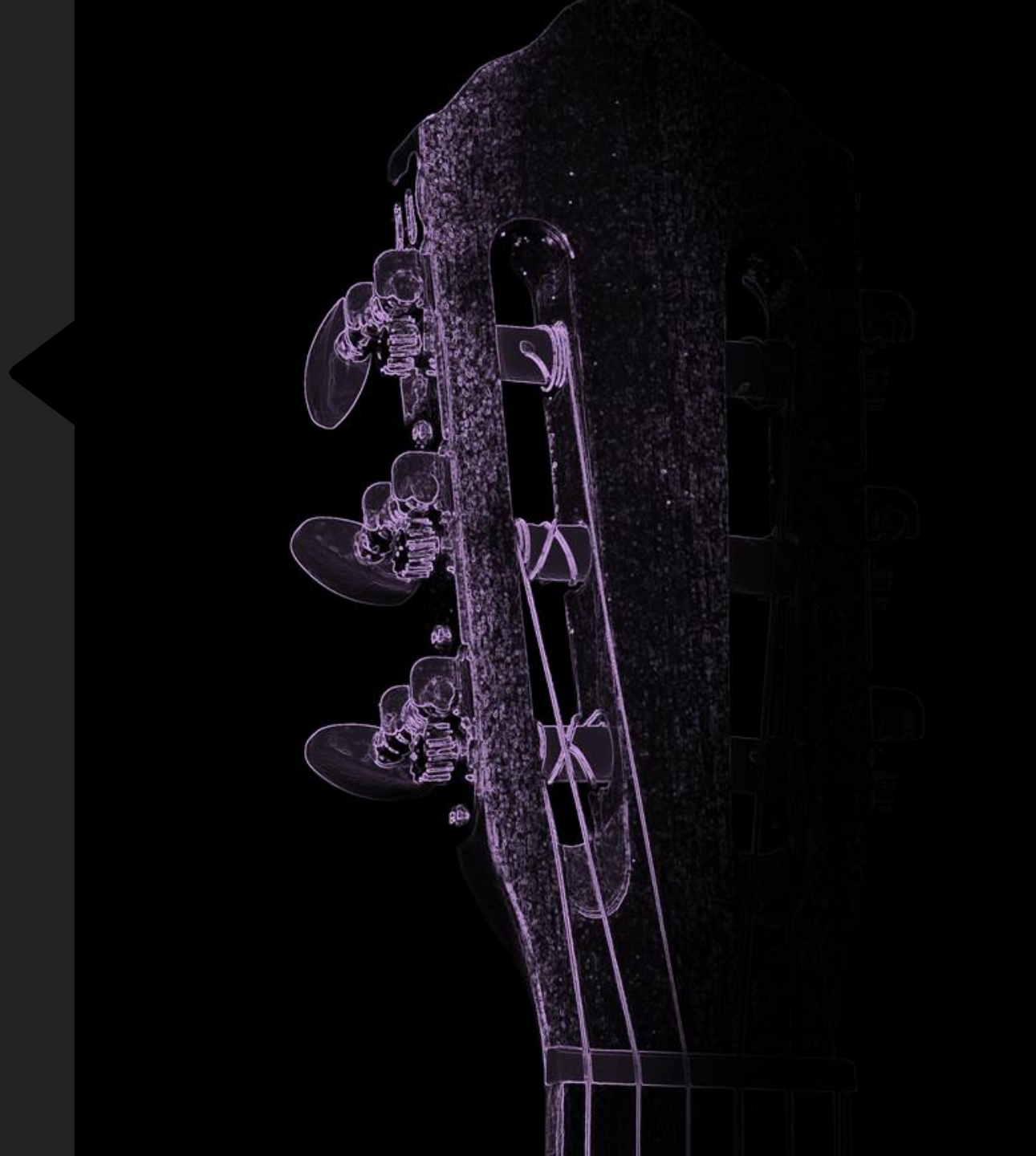


Latest research

- Online Generative Model Personalization for Hand Tracking
  SIGGRAPH Asia 2017
  - new algorithm for real-time hand tracking on commodity depth-sensing devices
    - jointly estimates pose and shape in each frame + determines the uncertainty in such estimates
  - does not require a user-specific calibration session
  - learns the geometry as the user performs live in front of the camera

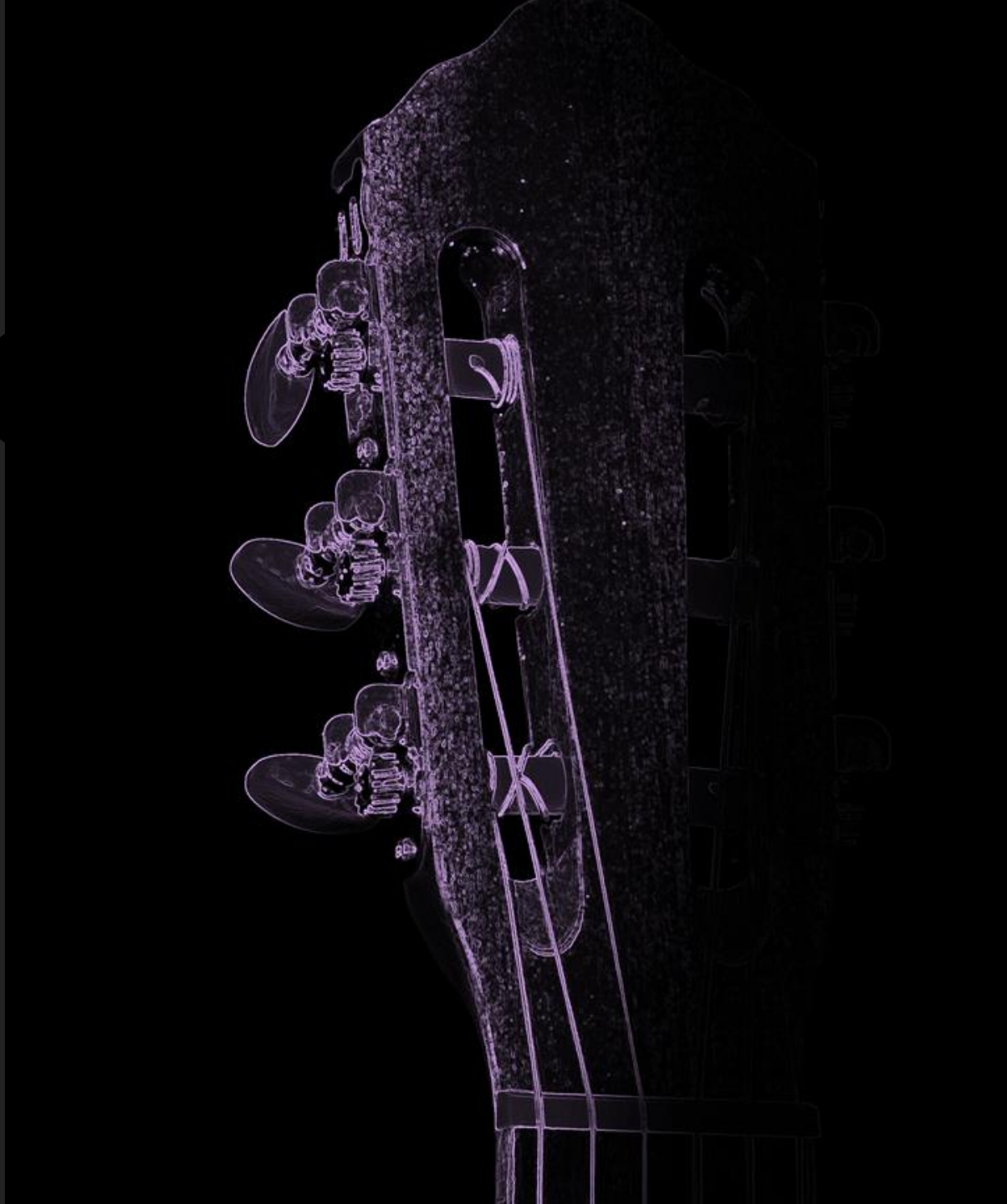
Focusing on guitar performance

- Motion Capture to Build a Foundation for a Computer-controlled Instrument by Study of Classical Guitar Performance
  J. C. Norton 2008
  - gloves - too bulky, not enough resolution or a high enough sampling rate (2008 ↔ now)
  - high speed video cameras based on marker identification
  - relative marker movement of each marker – filtering the compound marker movements

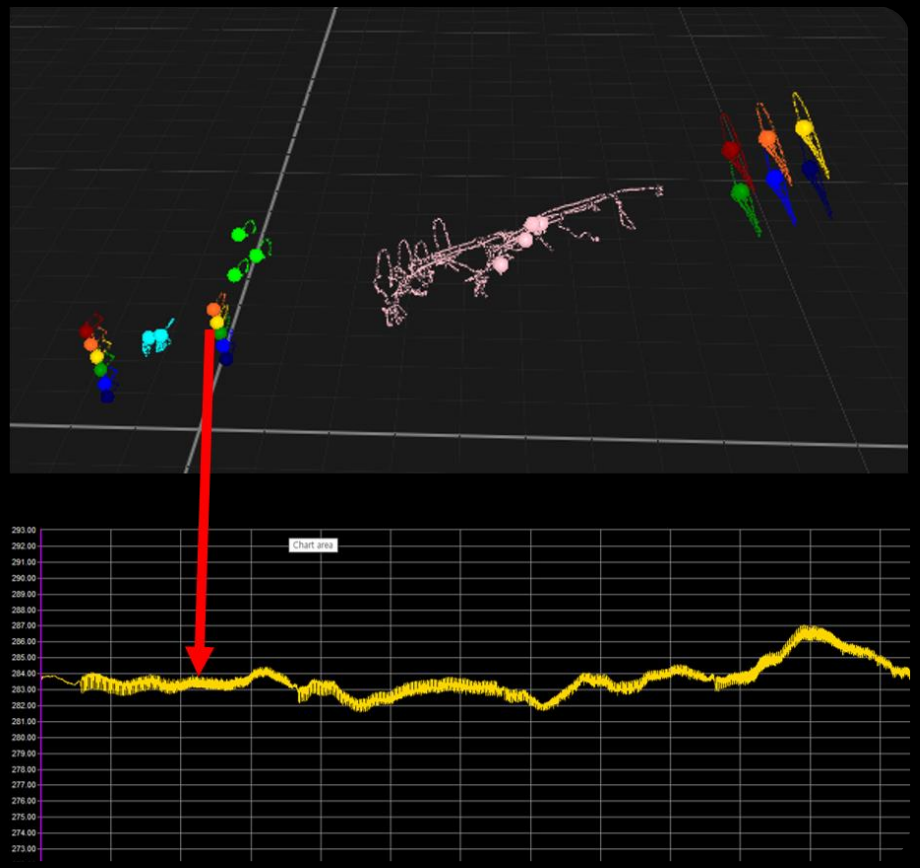


Focusing on guitar performance

- "Phantom Axe": A Motion Capture Air Guitar
  David Findon 2016
  - is it possible to use gesture control to play a virtual instrument?
  - program prototype
    - using **Microsoft Kinect** to track full body gestures
    - limitations – the sensors inability to track finger movements (only the tip of the hand and the wrist)
    - **Leap motion** - much more accurate for tracking hands and fingers, <u>but</u> is not able to track whole body



musician's motion



the string vibration

Sound oriented

- Hidden melody in music playing motion: Music recording using optical motion tracking system
  M. Song (2016)
  - Recording a sound using optical devices
  - optical marker-based motion tracking IR cameras
  - **high spatial precision** + **high sampling rate** => also the local acoustic vibrations can be recorded, which can be transformed to actual sound radiating from the acoustic instrument

Process

1. Data collecting – realtime
   - setting up the equipment
   - capturing the motion
2. Data analyzing and processing - offline
   - device wrapper (c++)
   - optimization, filtration, synchronization
   - reducing the noise
3. Data output
   - export into output file - BioVision Hierarchical motion capture data (.bvh) or such
   - **optional**: rendering in virtual reality (Unity) – animated figure

Process - detail

- Two basic phases of captured motion processing
  1. Real-time construction of a virtual skeleton which can be used for immediate feedback
     - sensor attachment
     - sensor input - software development kit (Localization C++ SDK or other)
  2. Offline processing which produces the articulated object
     - synchronization of data captured by multiple devices (gloves, camera)
     - filtration, noise reduction (limited number of sensors, sensor slip, sensor noise..)
     - inverse kinematic optimization - algorithm to produce the desired joint angle trajectories

Process - detail

- Close attention to be paid to
  - offsets from sensors on the surface of the body (hands) to the skeleton,
  - error introduced by surface deformation relative to the skeleton

The End