tgarden project

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future computing environments seminar
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map

- context
- experience
- experimental methodology
- physics
- system

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collaborators

Executive Director
Sha Xin Wei, Georgia Tech + sponge

Creative Directors
Sha Xin Wei
Maja Kuzmanovic, FoAM
Chris Salter, sponge
Laura Farabo, sponge

Technical Direction
Sha Xin Wei

Project Management
Chris Salter
Maja Kuzmanovic

Garments
Evelina Kusaite, FoAM
Maja Kuzmanovic
Cynthia Bohner-Vloet
Cocky Eek
Peggy Jacobs
Marchel van Doorn
Margot Annuschek

Sound Design and Production
Joel Ryan, STEIM
Chris Salter

Visual Design
Maja Kuzmanovic

Video Effects and 3D Graphics
Hiaz, xdv
Nik Gaffney, FoAM

Sensors + Wireless LAN
Stock, V2
Ozan Cakmakci, Starlab

Vision Tracking
Yifan Shi, Georgia Tech
Aaron Bobick, Georgia Tech

Room Dynamics
Sha Xin Wei
Nik Gaffney
Yon Visell
Steven Pickles

Network, Systems Integration
Nik Gaffney

Creative and Supportive Fellows
Sam Auinger
Aaron Bobick, Georgia Tech
Jay Bolter, Georgia Tech
Sara Diamond, Banff Centre for the Arts
Mark Goldstein
Anne Nigten, V2 Lab
Mark Scheeff
Beau Takahara, Ground Zero

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institutions

- sponge, San Francisco http://sponge.org
  FoAM, Brussels http://www.f0.am
  Georgia Institute of Technology, Atlanta, http://www.gvu.gatech.edu/ & http://www.lcc.gatech.edu/
  V2, Rotterdam, http://www.v2.nl/
  Ars Electronica Center, Linz http://www.aec.at
  Banff Centre for the Arts, Banff Canada http://www.banffcentre.ab.ca/CFA/
  Australian Network for Art and Technology, Australia
  Daniel Langlois Foundation for Art, Science, and Technology, Canada
  Flemish Ministry of Culture, Belgium
  FUTURE PHYSICAL (East England Arts / shinkansen)
  The Arts Council of England New Audience Programme

multiple norms

- Theater
  - After Bertold Brecht, Heiner Müller, Robert Wilson, Pina Bausch ...?
- Experimental Phenomenology
  - Ethnography and experience of play
  - Writing as performance
- Responsive Environments
  - Wearable and ubiquitous computing
  - Mixed reality
  - Authoring systems

experience

THEMES

- Dissolving and forming objects from continua
- Camouflage play
- Improvising gesture

Concept

Documentation (Ars Electronica, V2)

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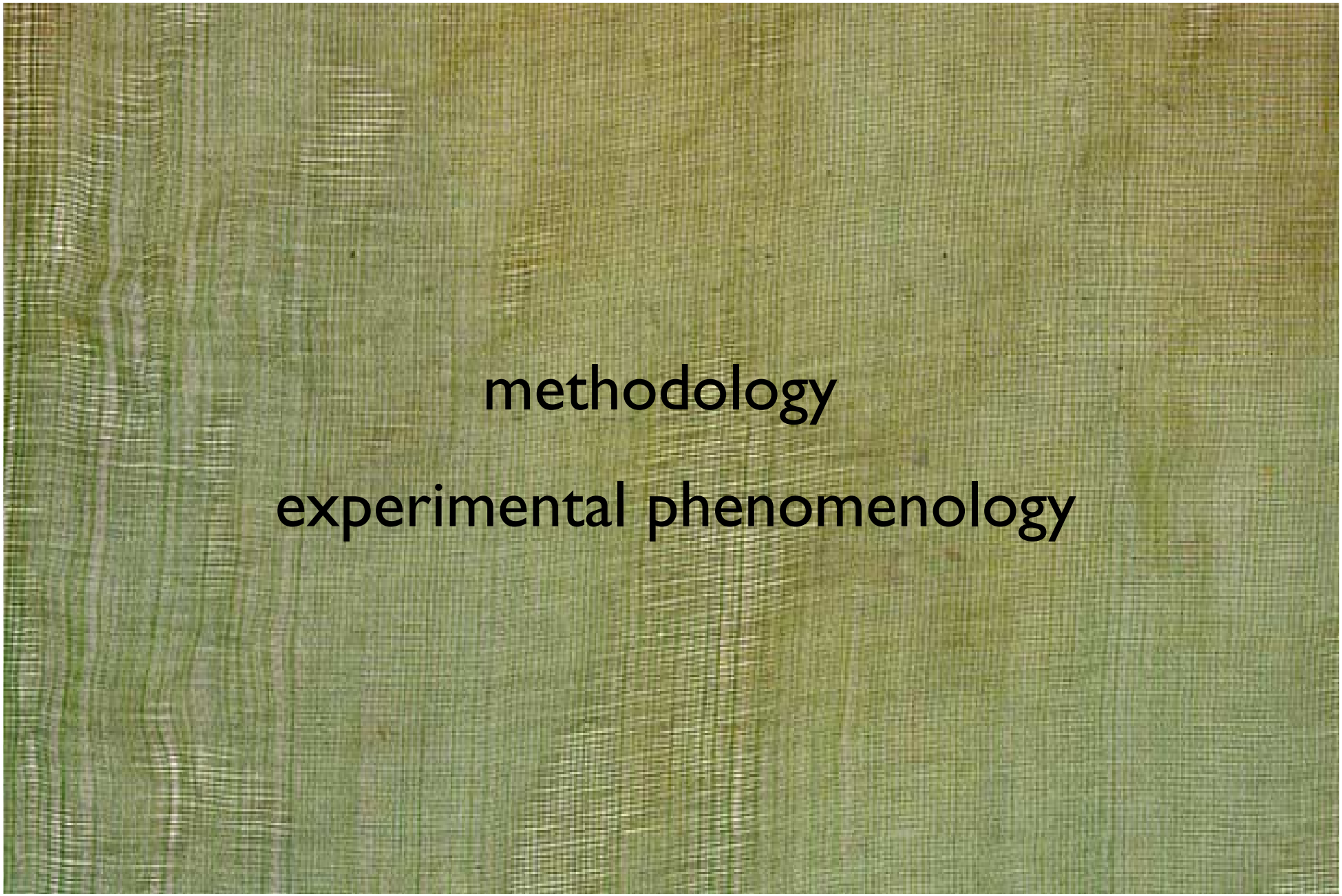
related work

- Theatrical Spaces
  - Myron Krueger
  - Studio Azzurro
- Responsive Environments
  - Alive
  - Kidspace
  - Aware Home
- Architectural Experiments
  - Diller + Scofidio
  - Christian Müller
  - Olivier Auber


methodology
experimental phenomenology

two forms of empirical work

- In vitro: standard bracketed conditions.
- In vivo: thick experience, toward field work

P. Dourish, Embodied Experience

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questions

In context of a continuously adaptive, responsive, media-rich environment:

- How do people invent gestures?
- How do people coordinate action without explicitly appealing to linguistic structures?
- How can a responsive space support development of virtuosity?
- How do people learn without explicitly appealing to linguistic structures?

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tgarden architecture

statistics

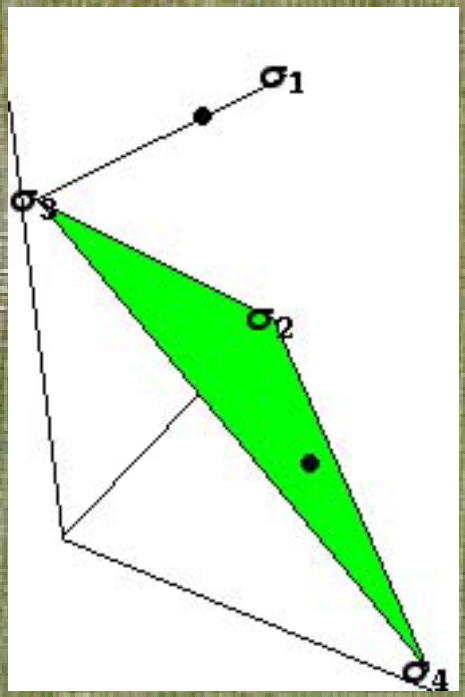
Intention and (Human) Learning

- Preliminaries
  - Calibration (accelerometers and IR)
  - Data throttling
  -
- Scalar vs 1d or 2d array
- Instantaneous or integral
- Integration over time or sample
  - Application: Leaky accumulator for slewing


phase space
TOPOLOGY

dynamical system

physics of mechanical systems, ode's



- Pure state: a meaningful experiential status
- State: (convex) combination of pure states
- Potential energy => dynamics sans player activity
- Kinetic energy <= player activity

V. I. Arnold

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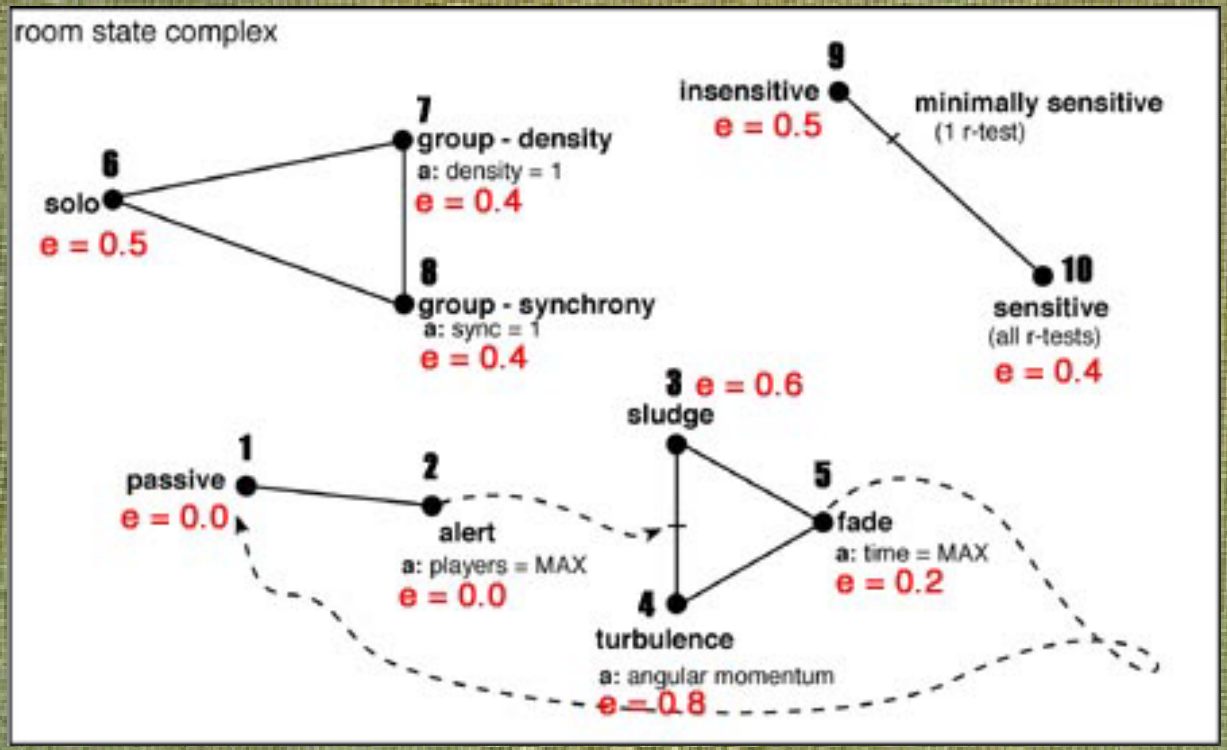
phase space topology: room

cantus firmus



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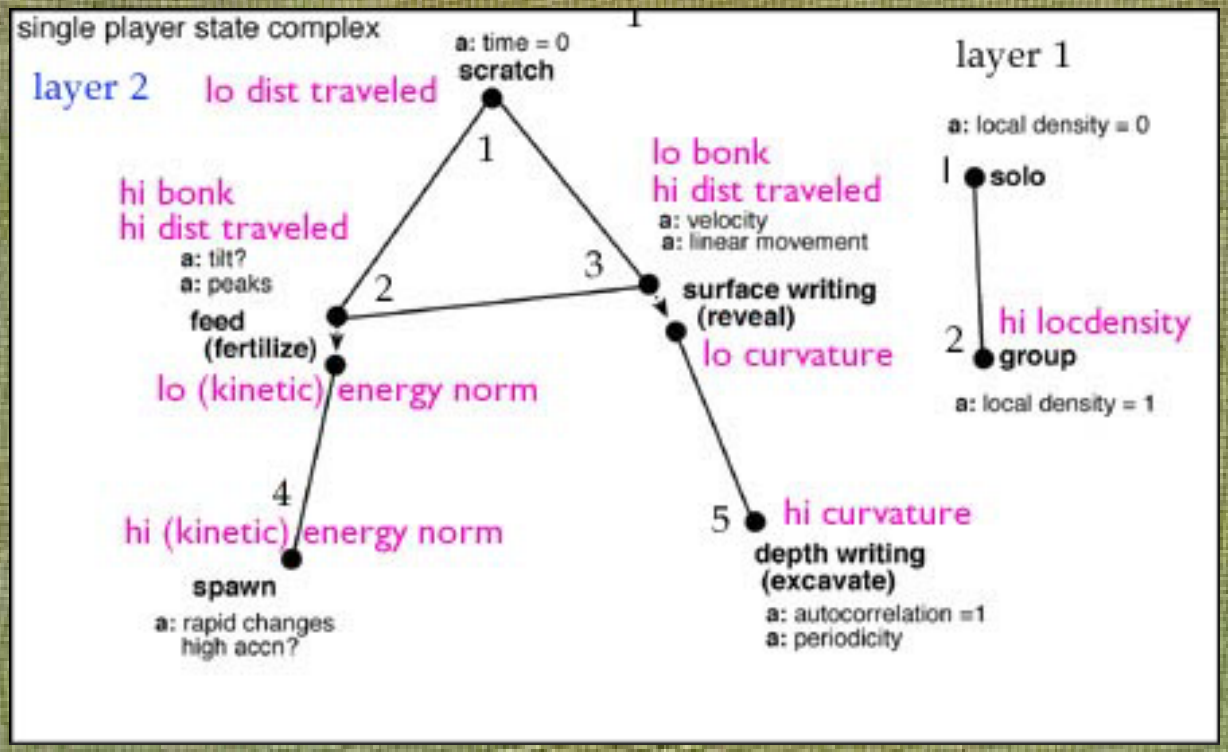
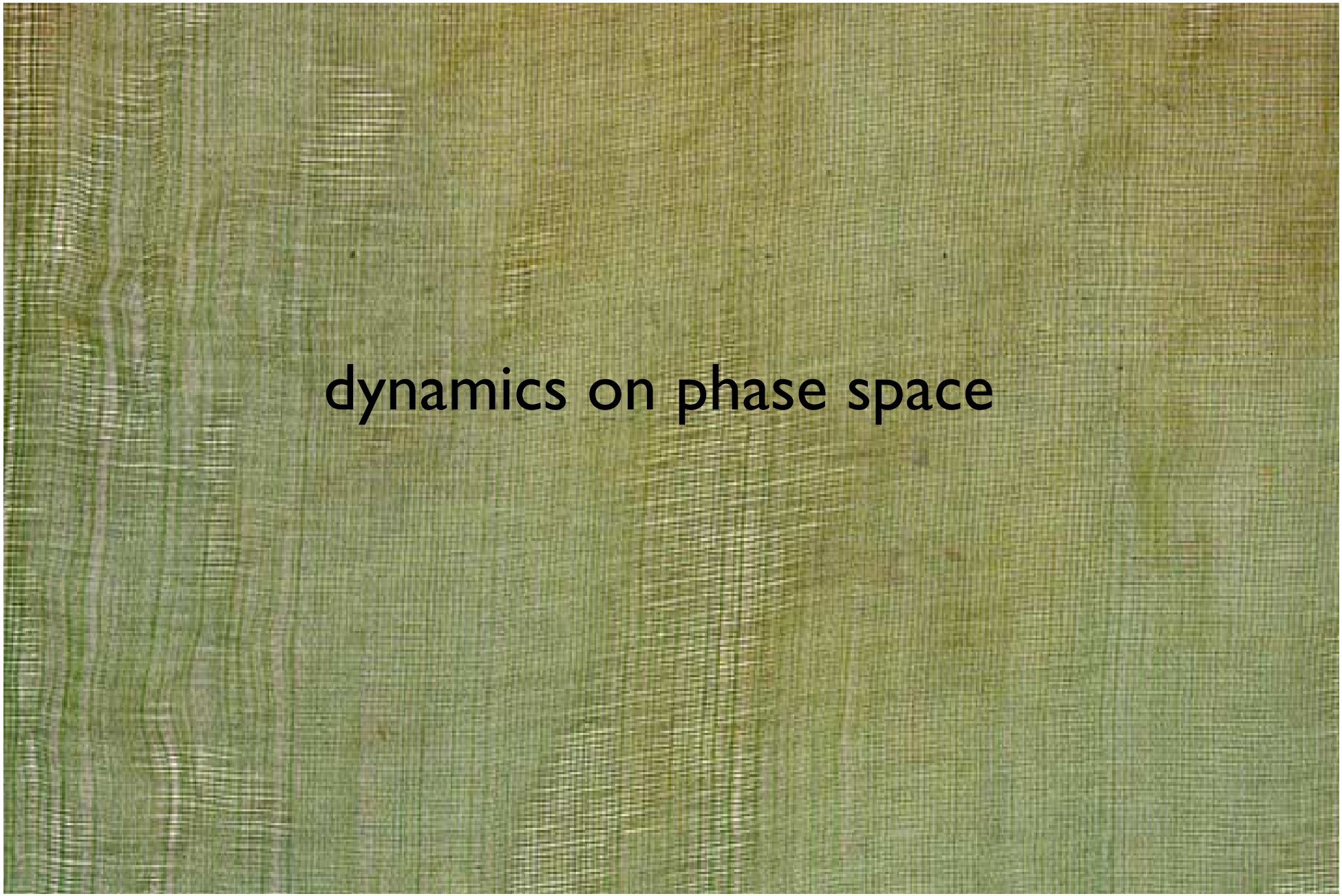
phase space topology: player




dynamics on phase space

dynamical system overview

- Player state can be represented by

$$S[p,t] := \sum_{i=1}^{n_s} \lambda_i[p,t] * S_i$$

where $\lambda_i \geq 0$ are the convex coefficients. $\sum_{i=1}^{n_s} \lambda_i \equiv 1$.

Oz associates an energy with each state

$$E[S(p,t)] := \sum_{i=1}^{n_s} \lambda_i[p,t] * e_i$$

$$e_i \equiv E[S_i] = \text{energy of state } S_i$$

Discrete states and discrete transitions are special case
Easy framework to handle noise, hysteresis.

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evolution dynamics

Sensor data $s_{\alpha i}$ is bundled into streams indexed by α:

$s = \{s_{11}, s_{12}, s_{13} \ldots; s_{21}, s_{22}, \ldots; \ldots\}$

m = pure state index,

α = sensor stream index,

i = index of particular sensor feature (channel) in a sensor stream.

Local structural data:

$g_{\alpha m}$ = coupling strength factor (constant) for state m, stream α,

u_m = static potential for state m,

$\mu_{\alpha mi}$ = expected mean value of sensor feature i, stream α for state m,

$\sigma_{\alpha mi}$ = expected variance of sensor feature i, stream α for state m,

$s_{\alpha i}$ = sensor feature i, stream α,

x_m = coefficient of state vector for pure state m,

G = global sensor coupling scalar,

$\hat{g}_{\alpha m} = g_{\alpha m} G$ = rescaled coupling

energy functional on phase space

Potential energy

$$U = \sum_m (1 - x_m)^2 \left\{ \sum_\alpha \hat{g}_{\alpha m} \sum_i \frac{(\mu_{\alpha m i} - s_{\alpha i})^2}{\sigma_{\alpha m i}} - u_m \right\}$$

Force in direction m

$$F_m = \frac{-dU}{dx_m} - \lambda \dot{x}_m$$

$$= (2x_m - 2)\left\{ \sum_\alpha \hat{g}_{\alpha m} \sum_i \frac{(\mu_{\alpha m i} - s_{\alpha i})^2}{\sigma_{\alpha m i}} - u_m \right\} - \lambda \dot{x}_m$$

with friction coefficient λ.

(F^t_m) = force tangent to the simplex.

project away {1,1,...,1} component

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equation of motion

(on phase space)

The evolution is given by

$$\dot{x}_m \rightarrow \dot{x}_m + \frac{1}{m} F^t_m \ \mathrm{dt}$$

$$x_m \rightarrow x_m + \dot{x}_m \ \mathrm{dt}$$

where

dt = integration timestep

m = mass of particle

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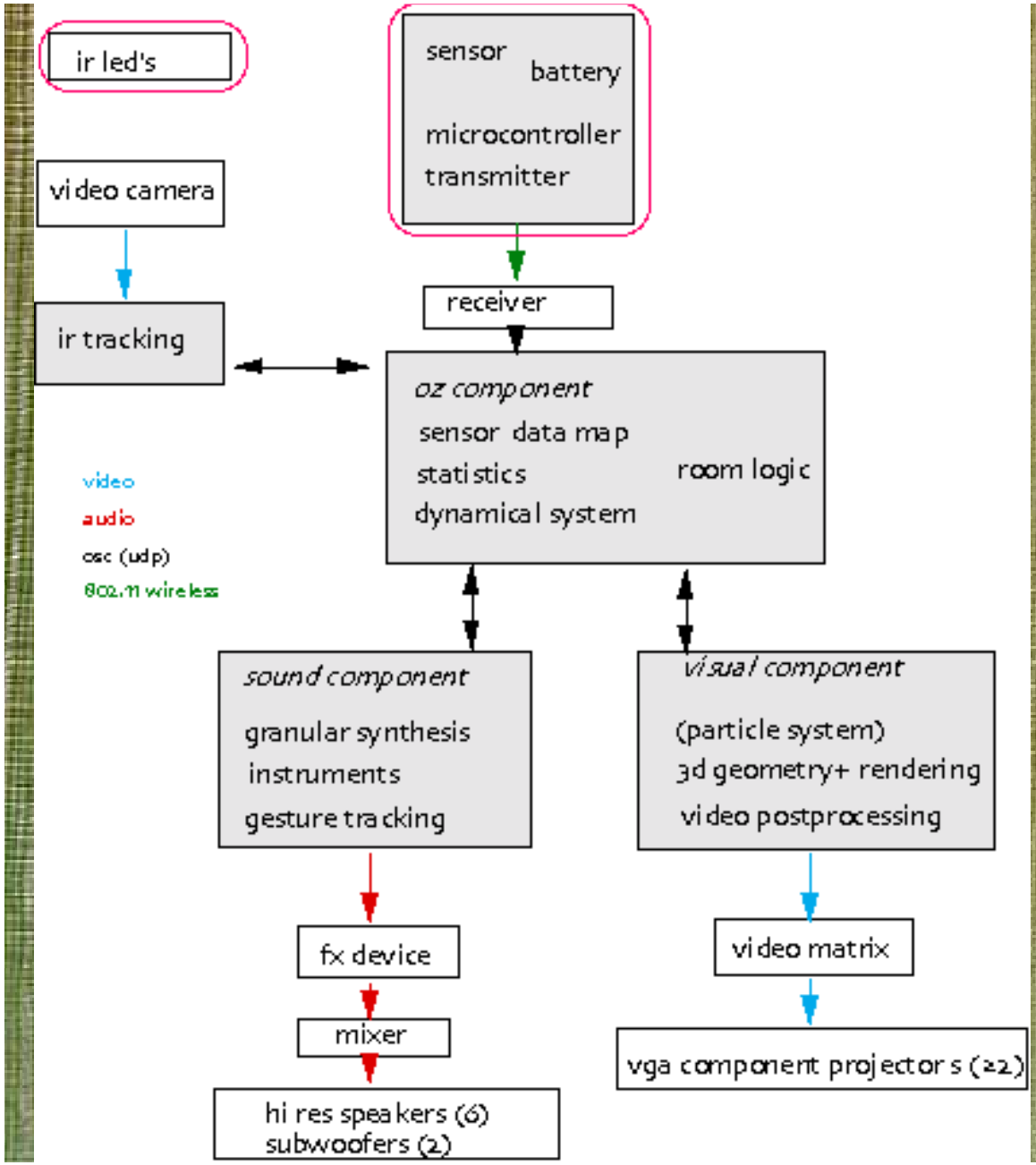
system architecture

system overview



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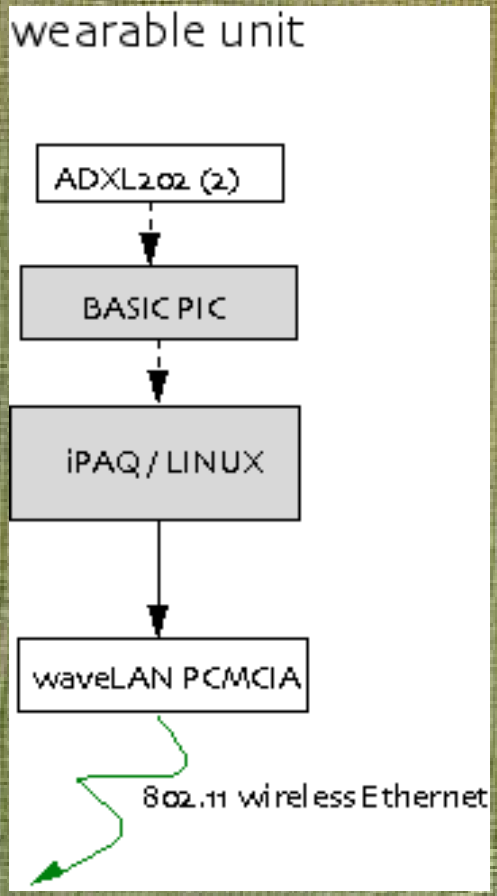
wearable



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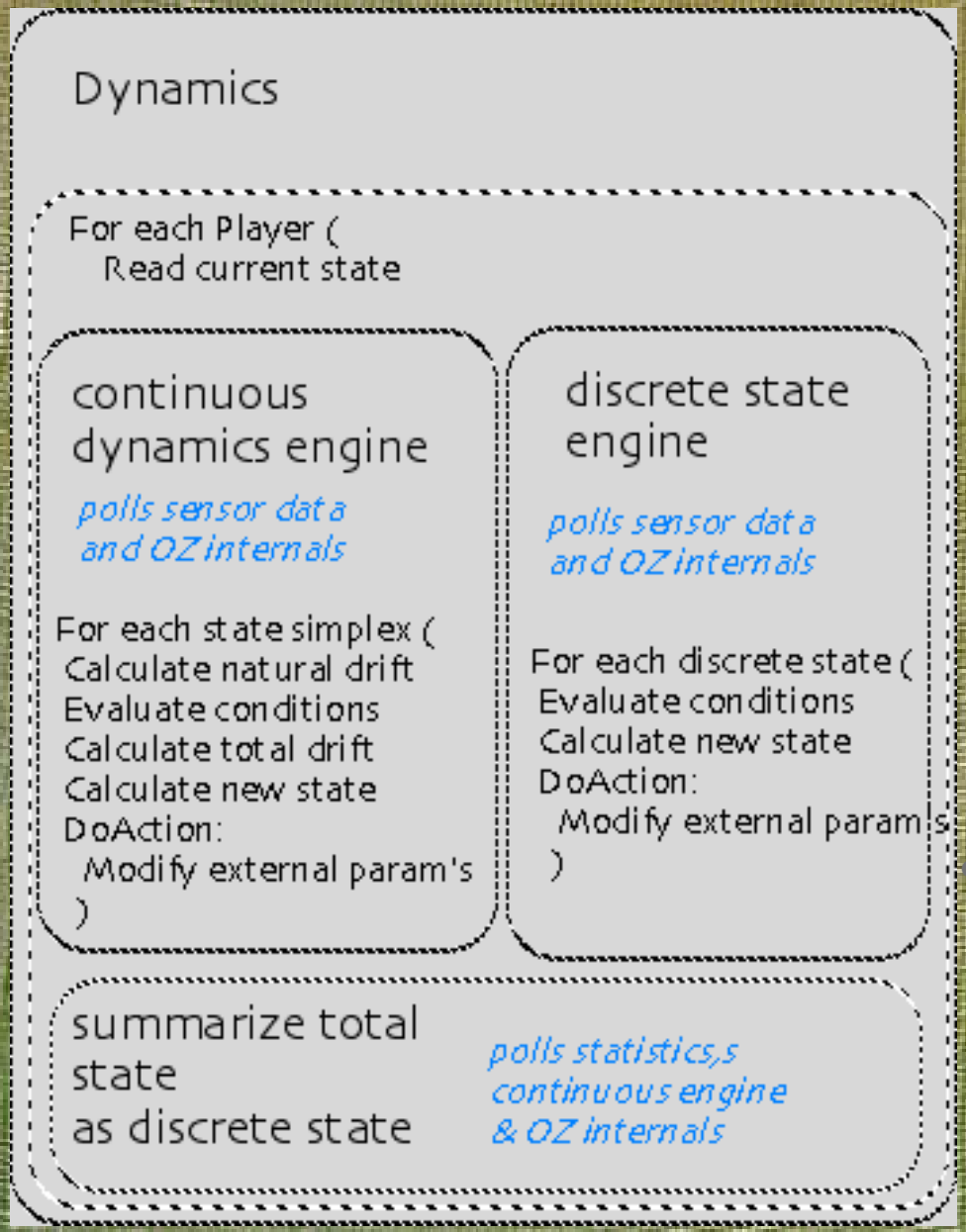

runtime causality

- Data-driven vs poll (push vs pull)

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runtime causality