

# **Giving a Hand to Kinect**

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# Problem statement

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Do not interfere with the action!

Microsoft Kinect

Given markerless visual observations,  
**detect and track in 3D**  
a performing hand

- 3D position/pose
- Full articulation

Unconstrained hand motion

**Plus hand posture recognition!**



# Is this an **interesting** problem?

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## □ **Theoretical interest**

- Humans solve it, can computers solve it, too?

## □ **Practical interest** in supporting the interpretation of human hand activities

- **Gesture Recognition**
- Human-Computer / Human-Robot interaction
- Sign language understanding
- Grasping
- Games
- ...



# Is this an **easy** problem?

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- Not really...
- A problem with high dimensionality...
- ... that needs to be solved based on relatively poor observations
  - Chromatically uniform appearance of the hand
  - Severe self occlusions
  - Severe hand/object occlusions (in case of hand/object interaction)
  - Distant views
  - Rapid hand motions



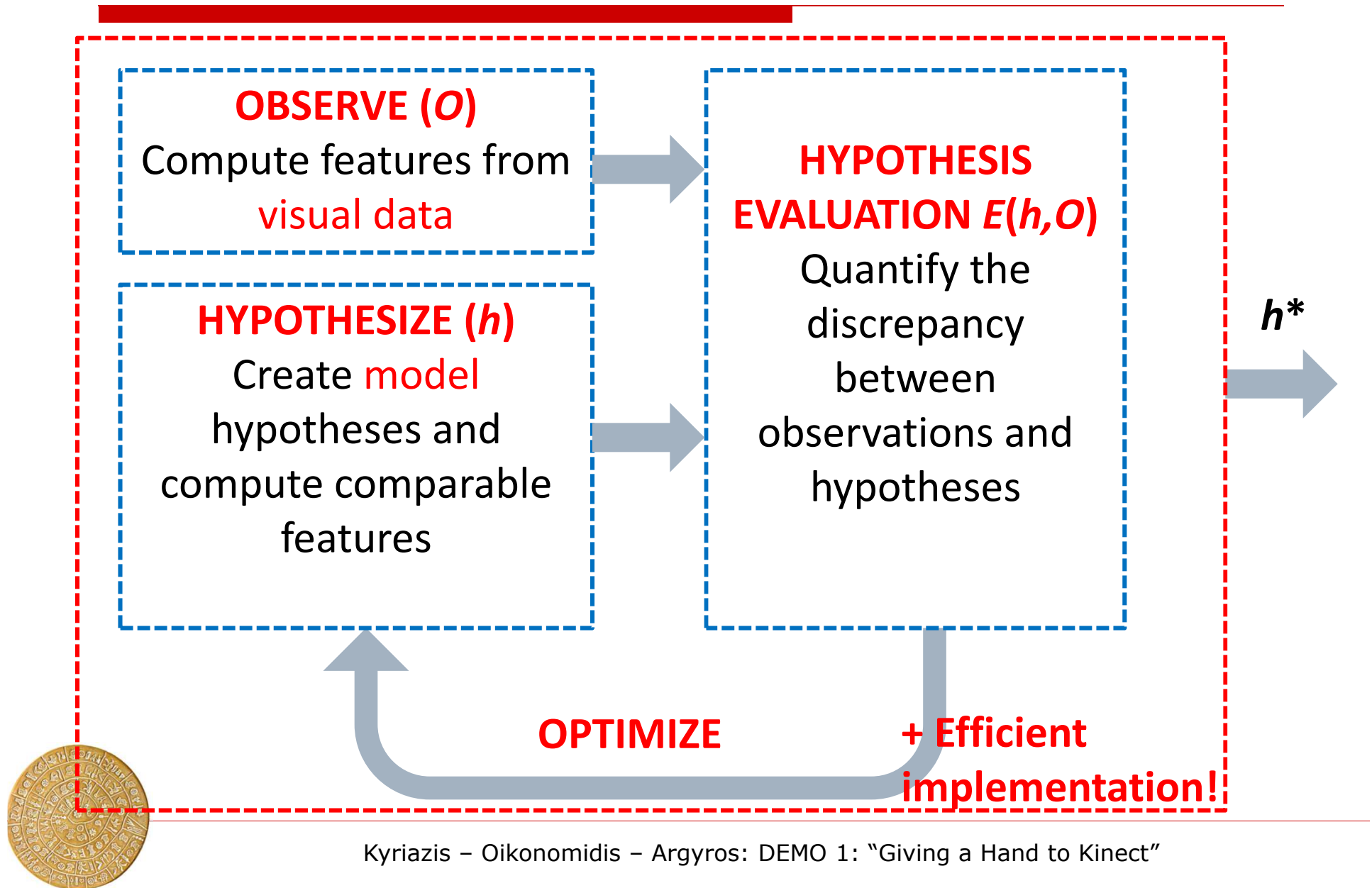
# Tracking the articulation of hands

- Estimate the full 3D position, orientation and articulation (i.e., all joint angles of a performing hand)

	<b>Multicamera setup</b>	<b>Kinect</b>
<b>A hand in isolation</b>	ACCV'2010	BMVC'2011
<b>A hand interacting with an object</b>	ICCV'2011	CVPR'2012



# The proposed framework

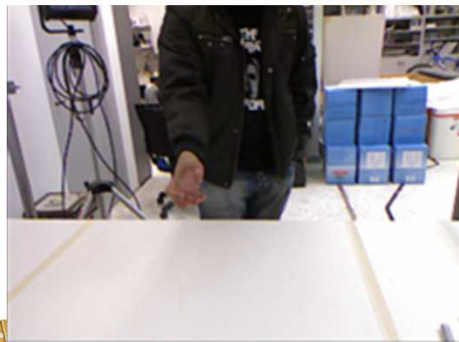


# 3D hand tracking based on RGB-D images

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- **The approach:**

- Get a Kinect frame as in (a), (b)
- Hand detection based on skin color and depth (c) [Argyros, ECCV 2004]
- Use the hand model of (d) (37 geometric primitives, 26 DoF)
- Fit the hand model (d) on the observation (c) with Particle Swarm Optimization to come up with the estimated hand pose (e)



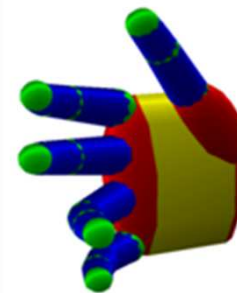
(a)



(b)



(c)



(d)



(e)



# 3D hand tracking based on the Kinect

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Efficient model-based 3D tracking of  
hand articulations using Kinect



I. Oikonomidis, N. Kyriazis, A.A. Argyros, "Efficient model based 3D tracking of hand articulations using Kinect", BMVC 2011, UK, September 2011.

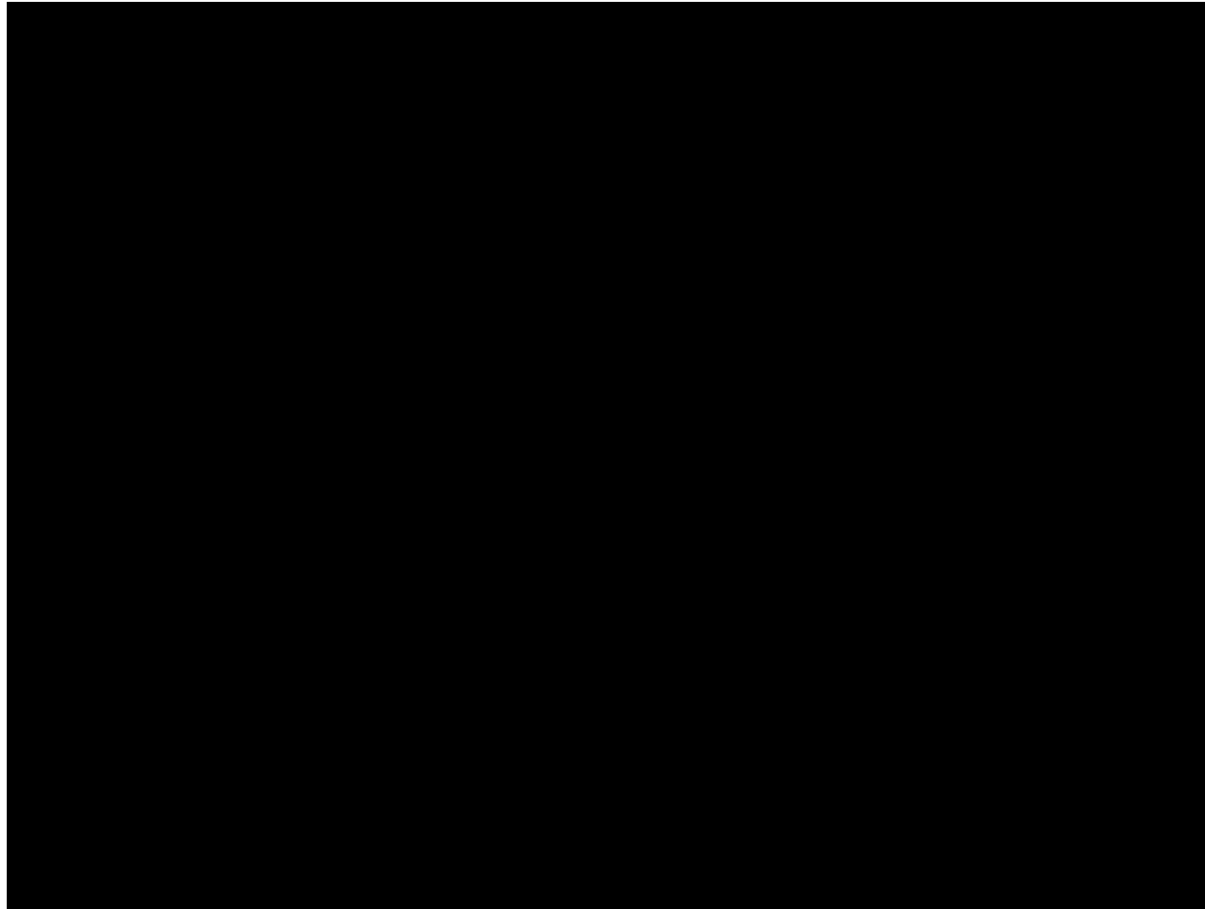
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Kyriazis – Oikonomidis – Argyros: DEMO 1: "Giving a Hand to Kinect"



# Tracking two strongly interacting hands

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I. Oikonomidis, N. Kyriazis, A.A. Argyros, "Tracking the articulated motion of two strongly interacting hands", CVPR 2012, Rhode Island, USA, June 2012.

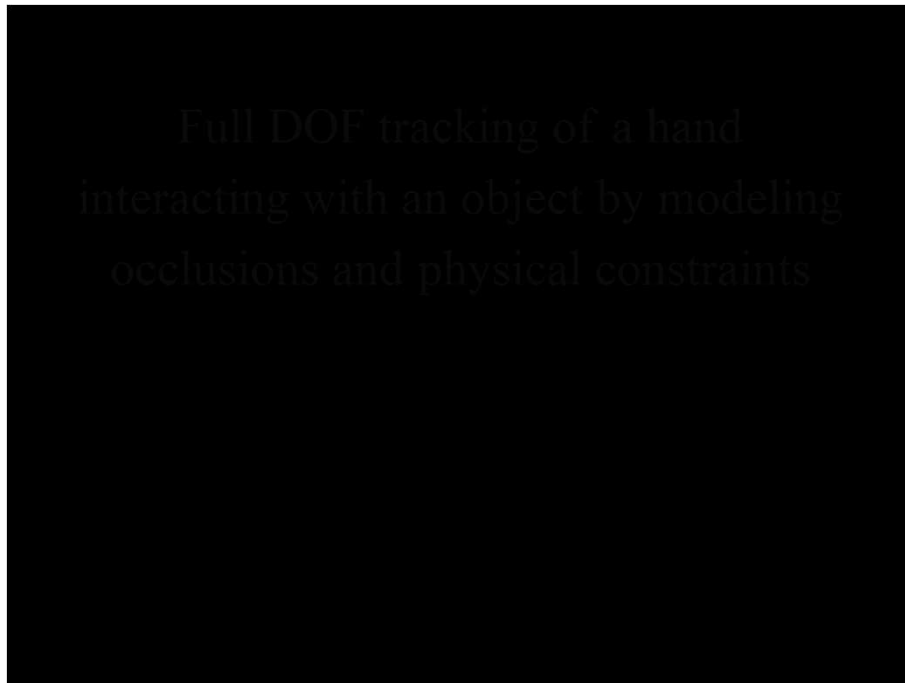
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Kyriazis – Oikonomidis – Argyros: DEMO 1: "Giving a Hand to Kinect"

# Same framework, other related problems

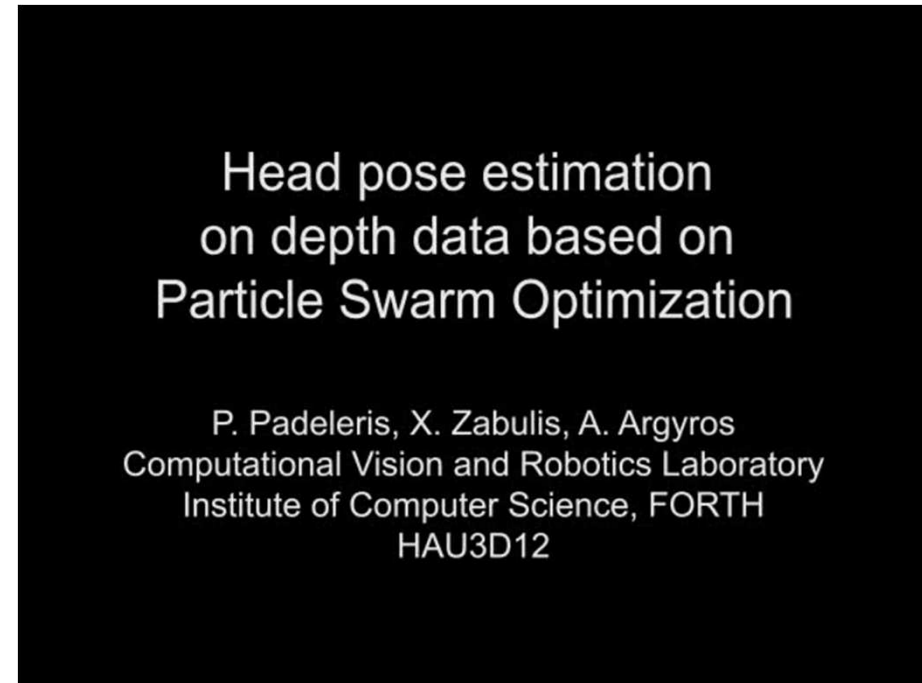
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## Tracking a hand in interaction with objects



I. Oikonomidis, N. Kyriazis, A.A. Argyros, "Full DOF tracking of a hand interacting with an object by modeling occlusions and physical constraints", ICCV 2011,

## 3D Head pose estimation



P. Padeleris, X. Zabulis and A.A. Argyros, "Head pose estimation on depth data based on Particle Swarm Optimization", in HAU3D'2012 (CVPR 2012 workshop)



# 3D hand tracking within ChaLearn

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- ❑ **Relevance:** Fundamental importance to gesture recognition
- ❑ **Usefulness:** Enabling technology for a diverse number of applications, several requests for cooperation from EU/US/Asia research labs and companies...
- ❑ **Technical and scientific contribution:** CVPR, ICCV, BMVC, ACCV, ...
- ❑ **Novelty/originality:** The first to demonstrate that a model-based approach can lead to practical hand tracking systems
- ❑ **Quality of implementation:** Demonstrator available for download (<http://cvrlcode.ics.forth.gr/handtracking>), a **library + API is on the way!**



## ... still

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- *“The proposed demo is **not a gesture recognition system** per se but **a robust 3D hand tracking system** which is however an essential component for many gesture recognition systems” (20/10/2012)*
  
- So, we developed a hand posture recognition system (in 2 days!) and brought it to you:
  - Select your preferred hand postures at run time
  - See how the system recognizes them



# Acknowledgments

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- Thomas Sarmis

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- GRASP



- robohow.cog



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**Thank you for your attention!**

We are not only looking **at** people...  
... we are also looking **for** people!!!

If interested, contact me:

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