



EXPERIMENT!



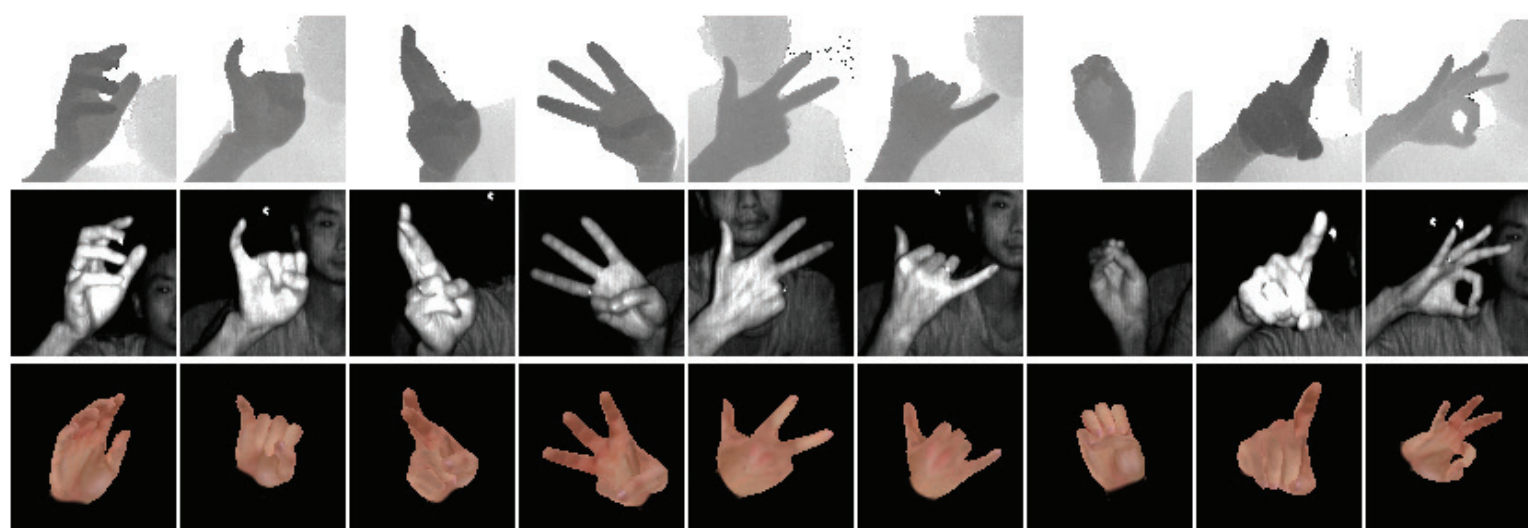
Bioinformatics  
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## Efficient Hand Pose Estimation from Single Depth Images

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### Overview

Our approach estimates 3D hand poses from single depth images.



### Difficulties

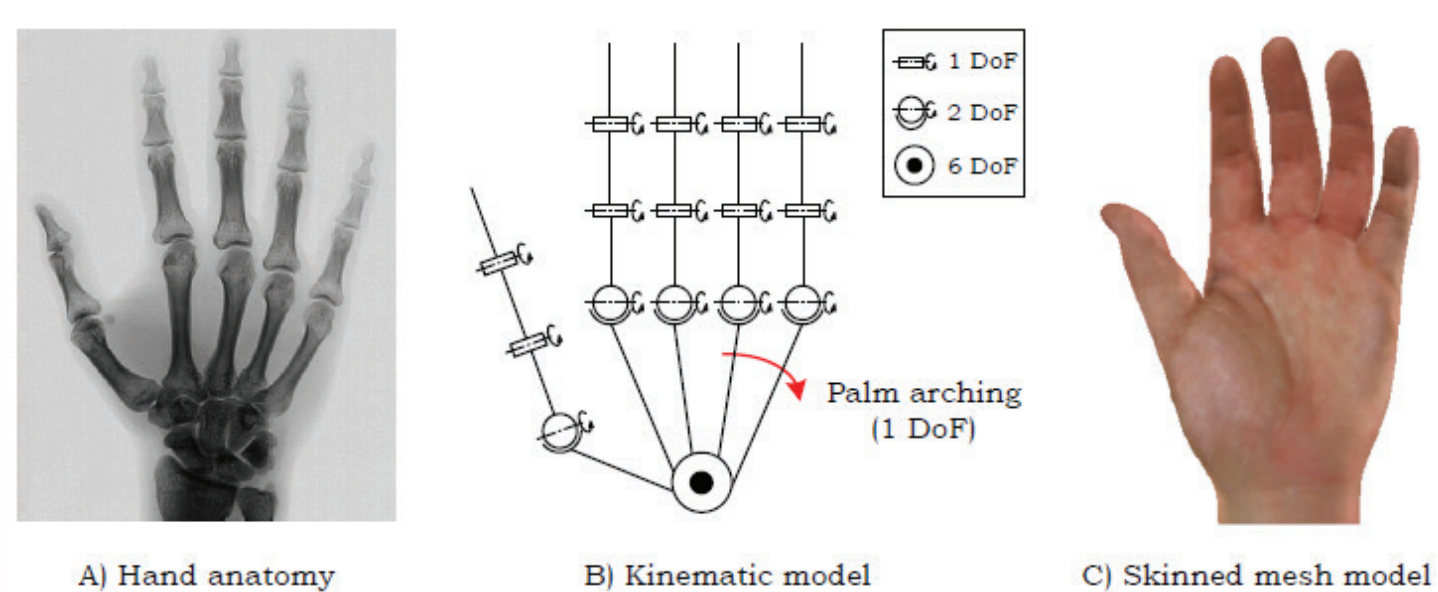
**Difficulty 1:** Large sample space vs. limited real data

- A hand has about 27 joints, if each discretized into 10 bins, the sample space is  $10^{27}$ . Difficult for motion capture to cover the space
- Alternative: Simulate many depth images from synthetic 3D hands

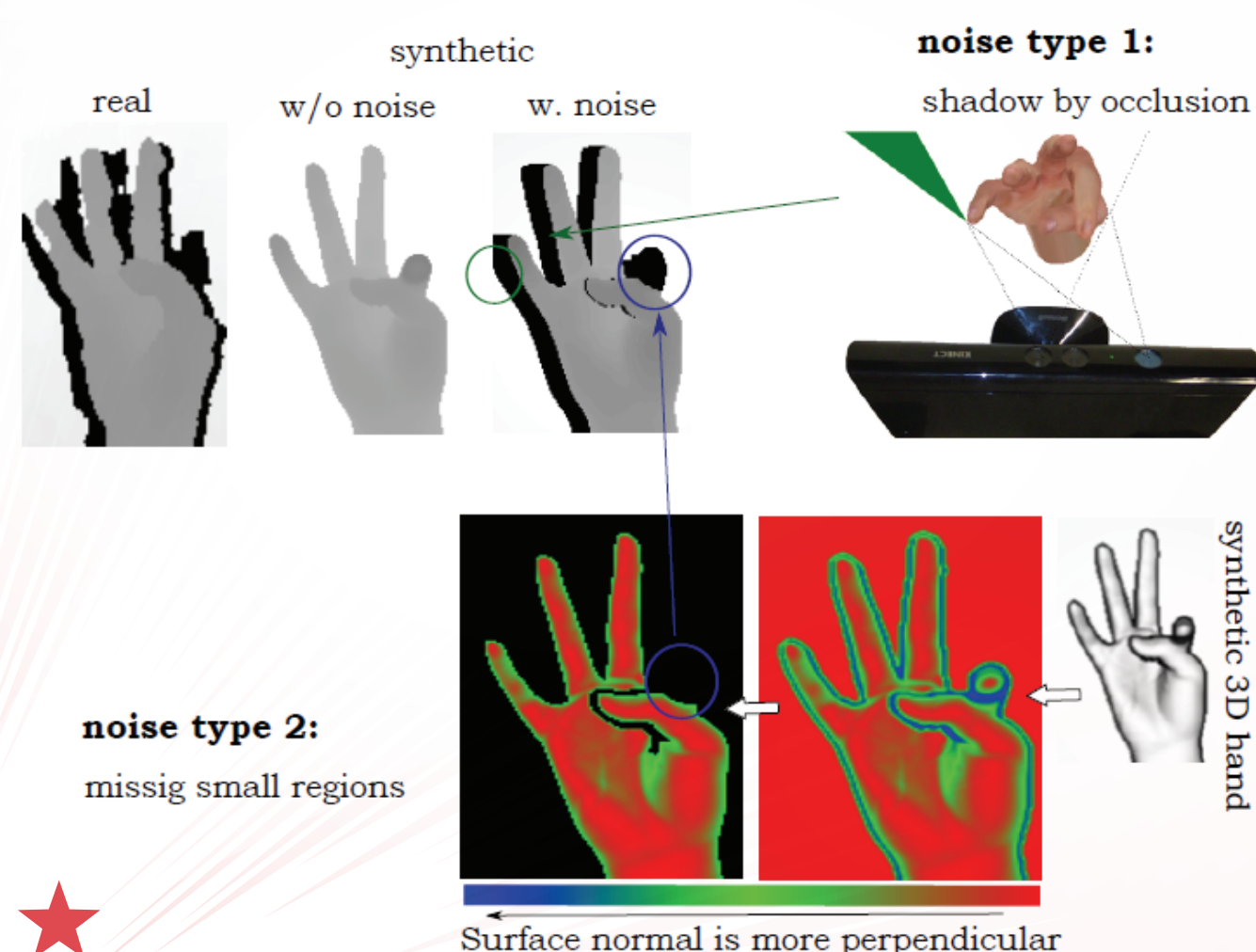
**Difficulty 2:** Depth noise

- Non-negligible noise comparing to ideal (synthetic) depth images
- Not the typical types of image noise (Gaussian, salt or pepper)

### Kinematic hand model



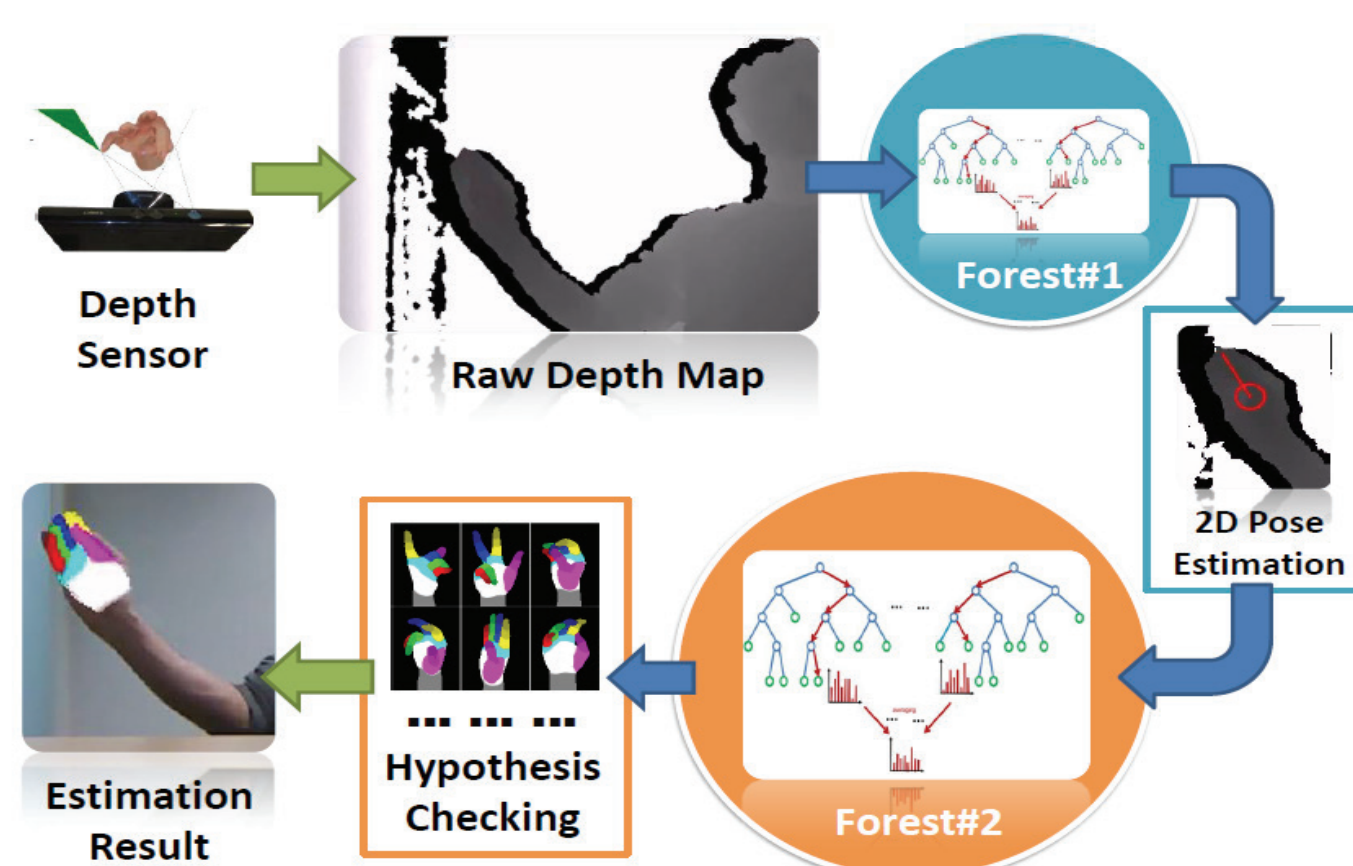
### Depth Noise Modeling



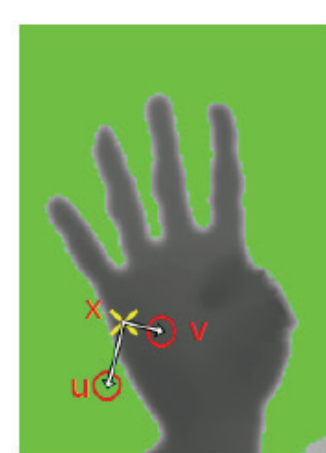
### Proposed Method

A dedicated **three-step pipeline** is proposed:

- Initial estimation
- Candidate generation
- Verification step



### Features

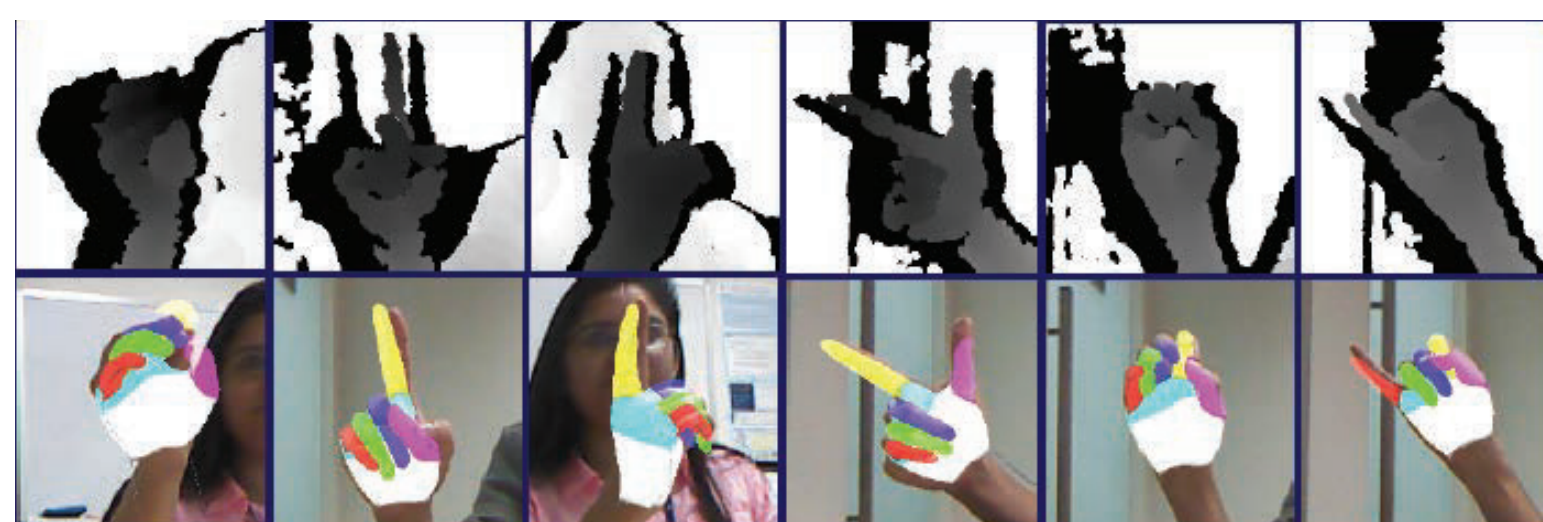


A feature at pixel  $x$  of input image  $I$ :

$$f_I(x) = d_I\left(x + \frac{u}{d_I(x)}\right) - d_I\left(x + \frac{v}{d_I(x)}\right)$$

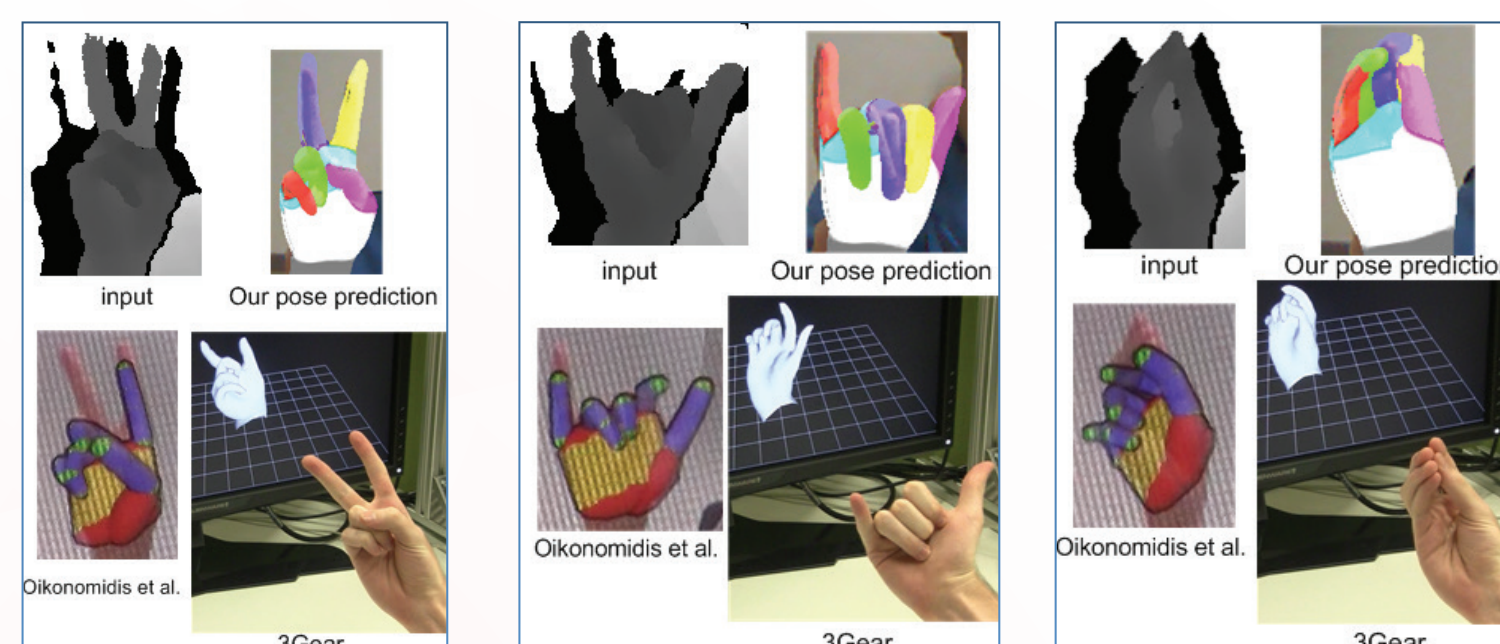
where  $d_I(x)$  is the depth value at pixel  $x$ , and  $u, v$  are two 2D-offsets

### Experimental Results



### Evaluations

	depth sensor only	depth noise modeling	large vocabulary (size $\geq 10$ )	work with real data
Ours [1]	✓	✓	✓	✓
Oikonomidis et al. [2]	✗	✗	✓	✓
Keskin et al. [3]	✓	✗	✓	✗
3Gear [4]	✓	✗	✗	✓



Reference:  
[1] Chi Xu, Li Cheng, Efficient Hand Pose Estimation from a Single Depth Image. International Conference on Computer Vision, 2013.  
[2] I. Oikonomidis, N. Kyriazis, and A. Argyros. "Efficient model-based 3d tracking of hand articulations using kinect". BMVC, 2011.  
[3] C. Keskin, F. Kirac, Y. Kara, and L. Akarun. "Hand pose estimation and hand shape classification using multi-layered randomized decision forests". ICCV, 2012.  
[4] 3Gear systems. <http://www.threegear.com>, Oct. 2012.

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