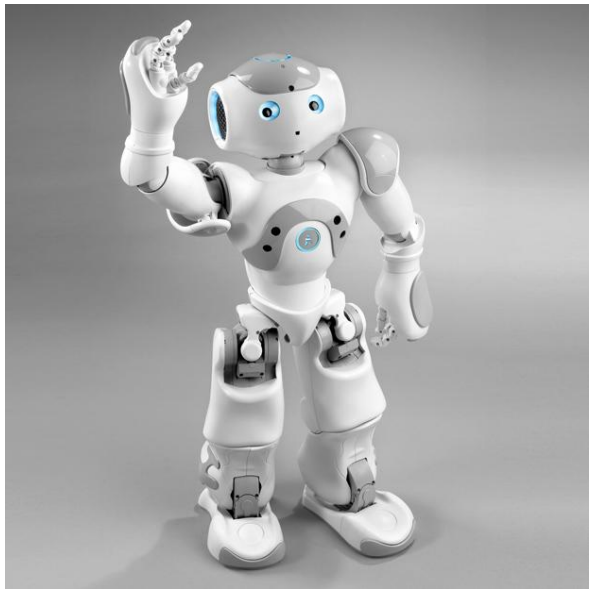
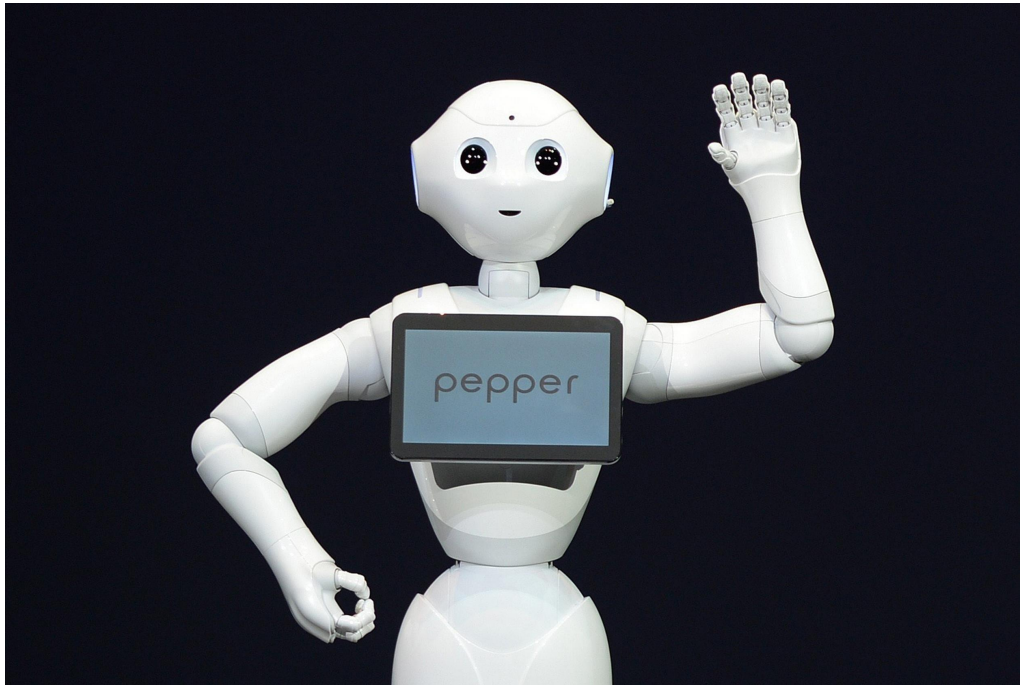
OpenCV 3.0

RGBD

Presentation

Vincent Rabaud from Aldebaran Robotics





Plan

1. Basics
2. Normals
3. Planes
4. Odometry
5. 3d Visualization
6. Future

Pre-Basics

Generic rules:

- do not use `cv_*` but `cv::*`
- forget about `CvMat, IplImage, import cv`
- use `cv::Mat_<*>` and `cv::Matx*`
- create `Algorithm`
- use `ts` module
- create your own module: `ocv_define_module`

Basics (1/2)

Depth image:

- in mm: `cv::Mat_<ushort>`
- in m: `cv::Mat_<float>, cv::Mat_<double>`

3d points: `cv::Mat_<cv::Vec3f>, cv::Mat_<cv::Vec3d>`

poses: `cv::Matx33f, cv::Vec3f`

Basics (2/2)

Check for depth validity

```
bool isValidDepth(...)
```

Conversions:

```
void depthTo3d(InputArray depth, InputArray K, OutputArray
points3d, InputArray mask = noArray());

void depthTo3dSparse(InputArray depth, InputArray K,
InputArray points, OutputArray points3d)
```

Normals (1/3)

Algorithm:

```
class RgbdNormals: public Algorithm
```

Papers:

- Fast and Accurate Computation of Surface Normals from Range Images`` by H. Badino, D. Huber, Y. Park and T. Kanade
- the normals with bilateral filtering from ``Gradient Response Maps for Real-Time Detection of Texture-Less Objects`` by S. Hinterstoisser, C. Cagniart, S. Ilic, P. Sturm, N. Navab, P. Fua, and V. Lepetit

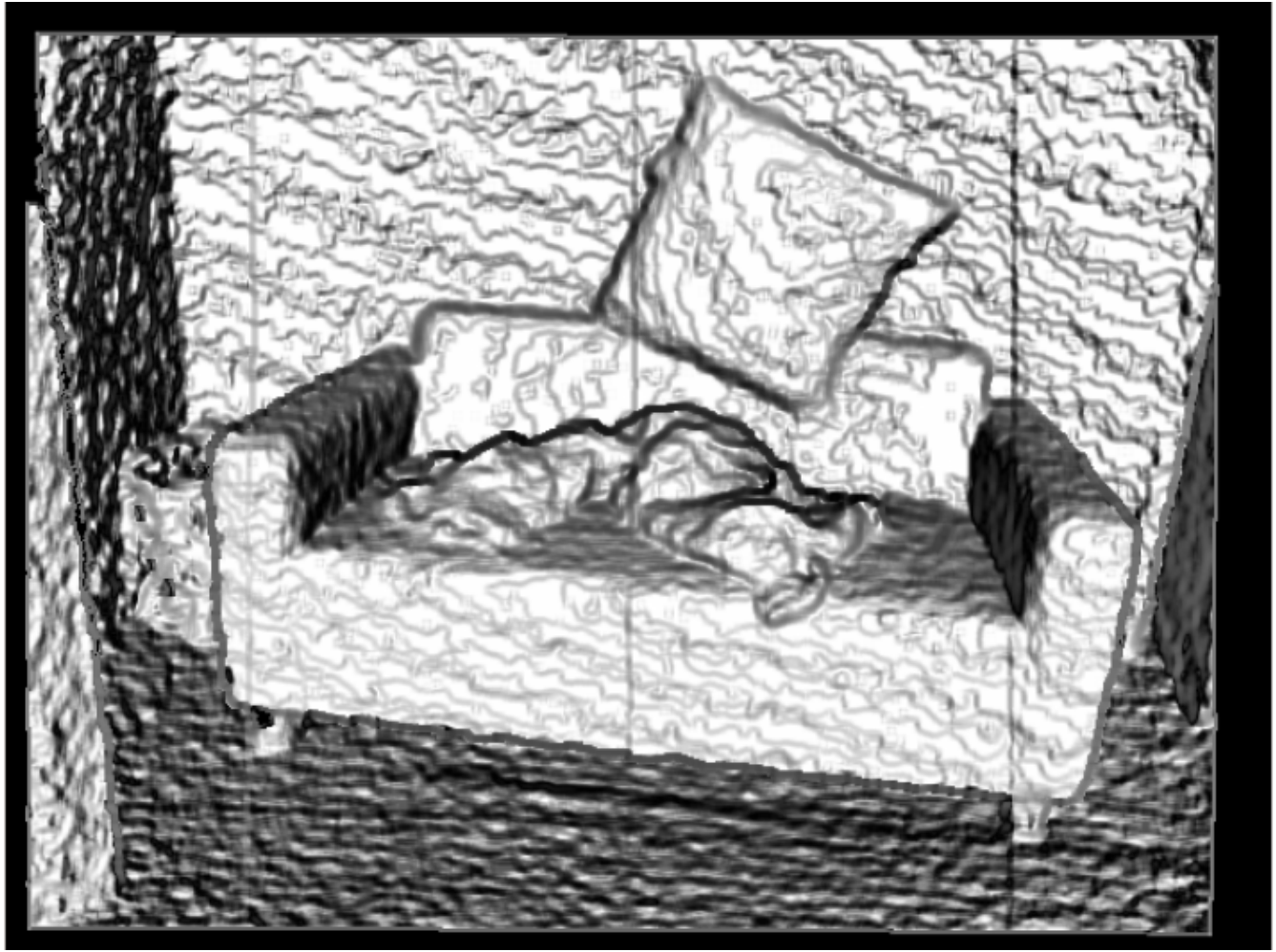
Normals (2/3)

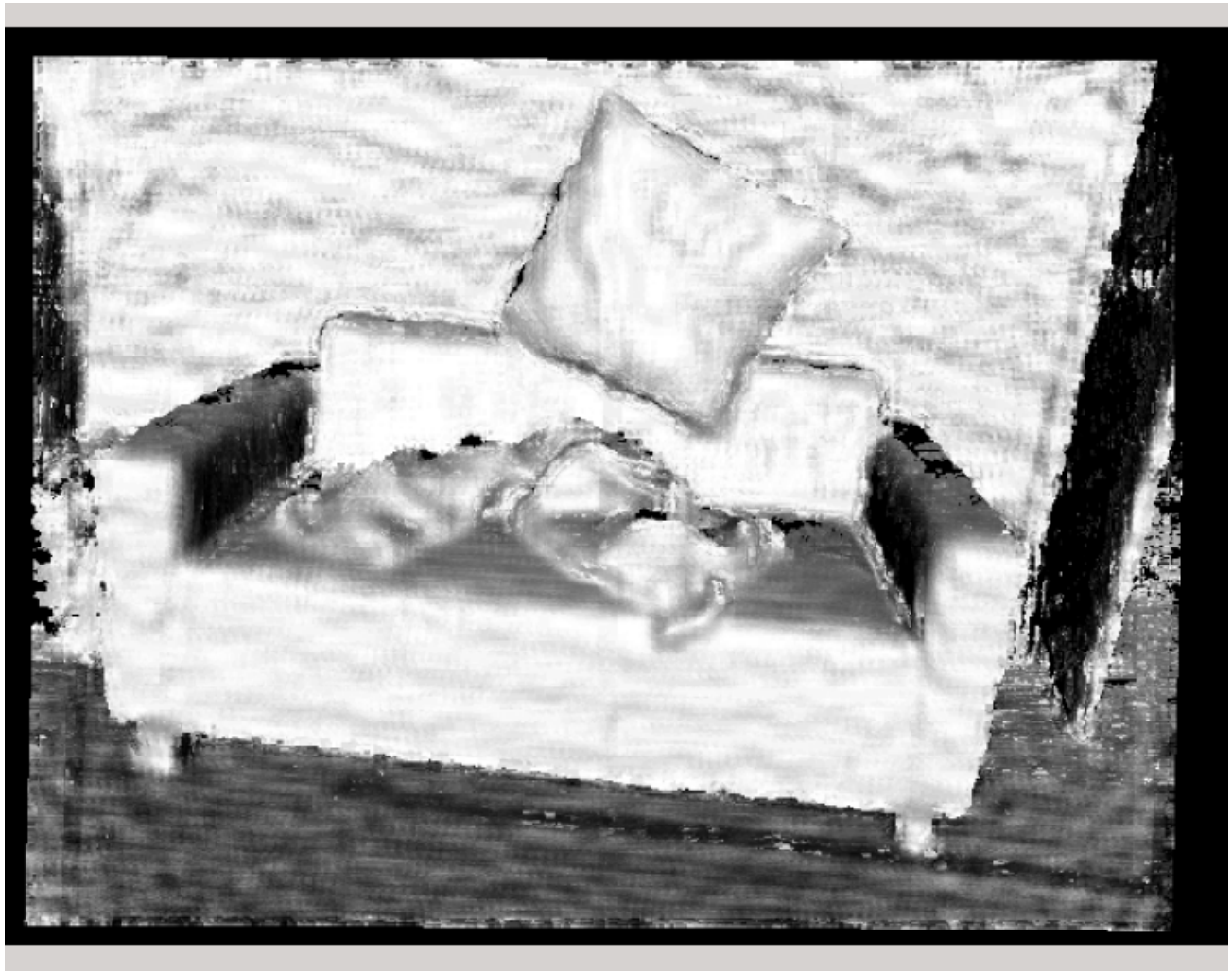
Initialization:

```
RgbdNormals(int rows, int cols, int depth, InputArray K,
int window_size = 5, int method =
      RGBD_NORMALS_METHOD_FALS)
```

Computation:

```
void operator()(InputArray points, OutputArray normals)
```





Normals (3/3)

Depth cleaner:

```
class DepthCleaner: public Algorithm

void operator()(InputArray points, OutputArray depth) const
```

Paper: ``Modeling Kinect Sensor Noise for Improved 3d Reconstruction and Tracking`` by C. Nguyen, S. Izadi, D. Lovel

Planes (1/2)

Algorithm:

```
class RgbdPlane: public Algorithm
```

Custom implementation inspired by:

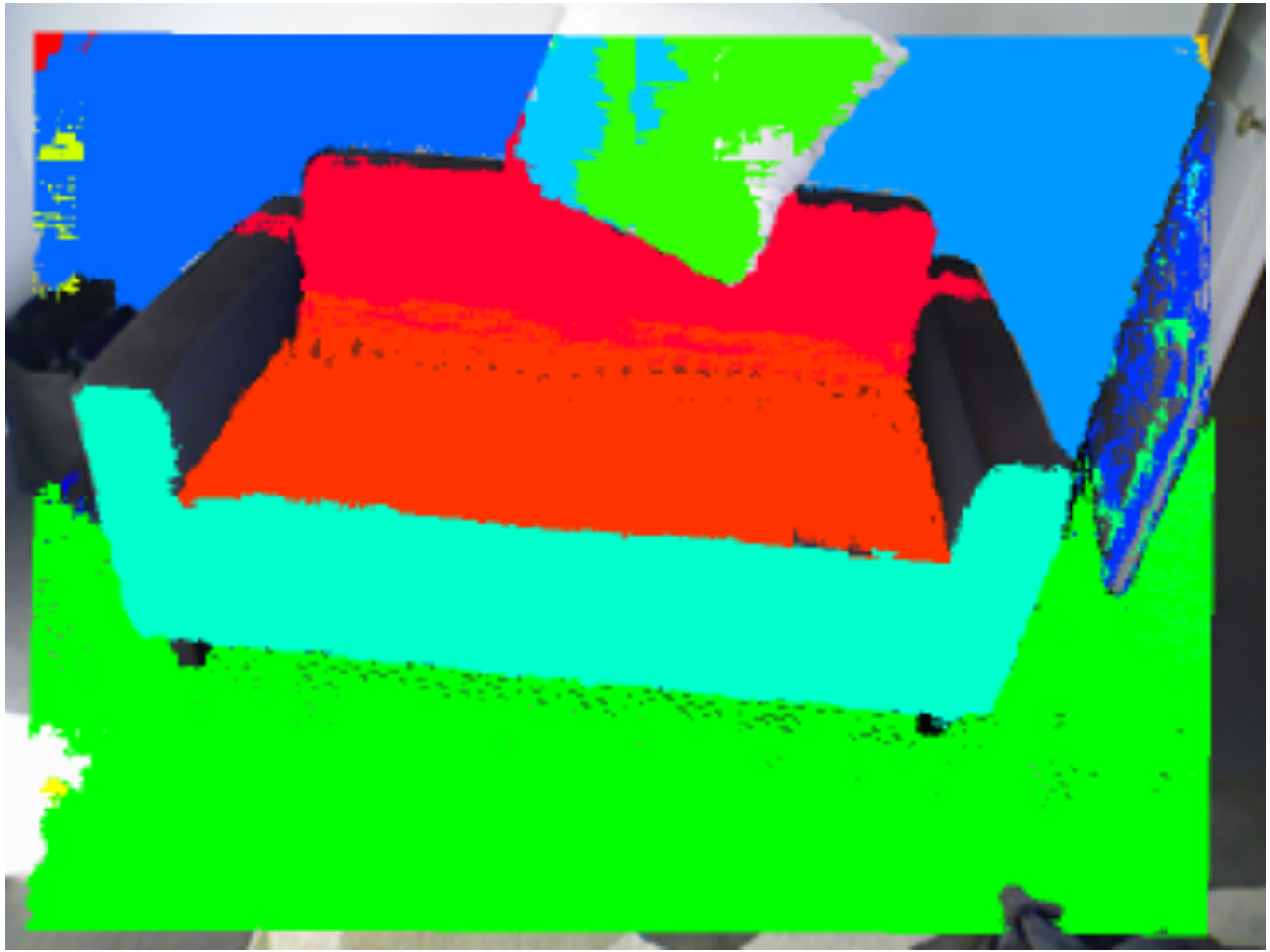
- Fast Plane Detection and Polygonalization in noisy 3D Range Images, Jann Poppinga, Narunas Vaskevicius, Andreas Birk, and Kaustubh Pathak
- Fast Plane Detection for SLAM from Noisy Range Images in Both Structured and Unstructured Environments Junhao Xiao, Jianhua Zhang and Jianwei Zhang Houxiang Zhang and Hans Petter Hildre

Planes (2/2)

calling:

```
void operator()(InputArray points3d, InputArray normals,
OutputArray mask, OutputArray plane_coefficients);
```

model for quadratic noise



Odometry

- Real-Time Visual Odometry from Dense RGB-D Images
- KinectFusion: Real-Time Dense Surface Mapping and Tracking
- demo

Visualization (1/3)

3d: VTK based

- primitives (planes, circles, lines …)
- point clouds (color, normals)
- meshes
- camera interactions

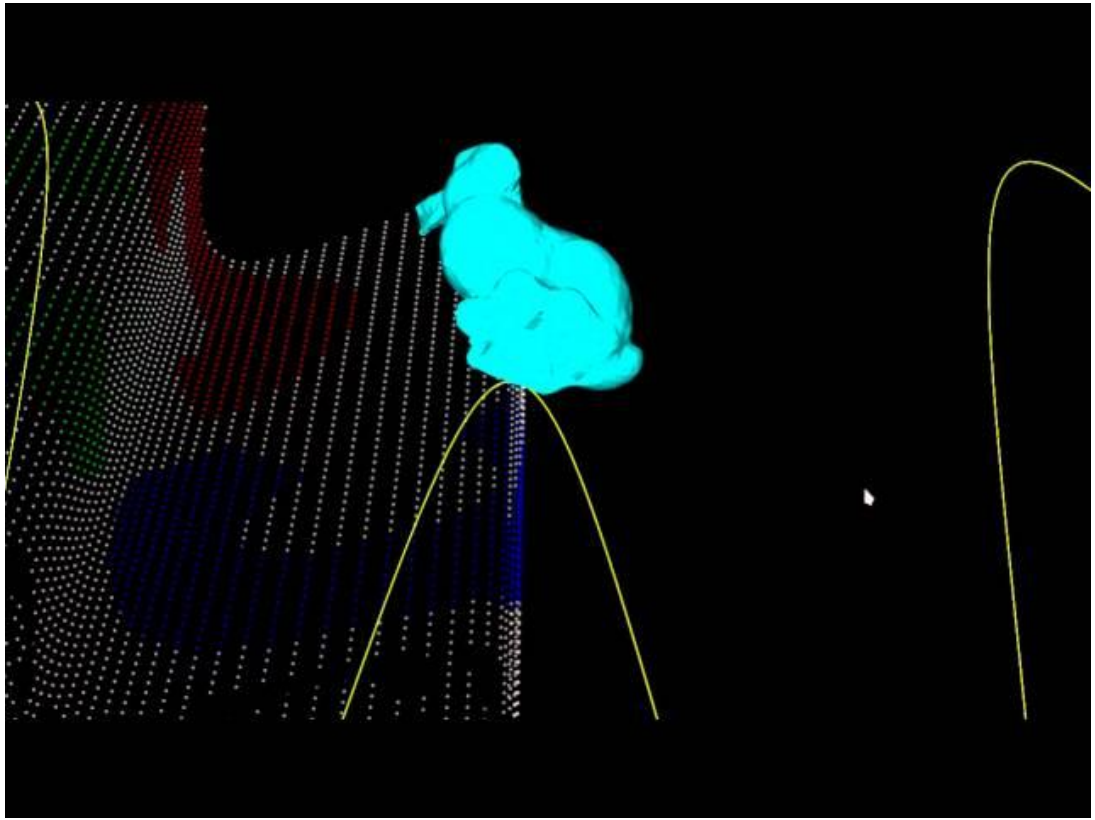
Visualization (2/3)

widget based

```
cv::viz::Viz3d myWindow("Coordinate Frame");
myWindow.showWidget("Coordinate Widget", cv::viz::
WCoordinateSystem());
```

```
cv::Mat cloud = ...;
cv::viz::WCloud cloud(cloud, cv::viz::Color::green());
myWindow.showWidget("cloud", cloud);
```

Visualization (3/3)



Future

- GSOC on pair-based descriptors
- DTAM
- still pending libmv