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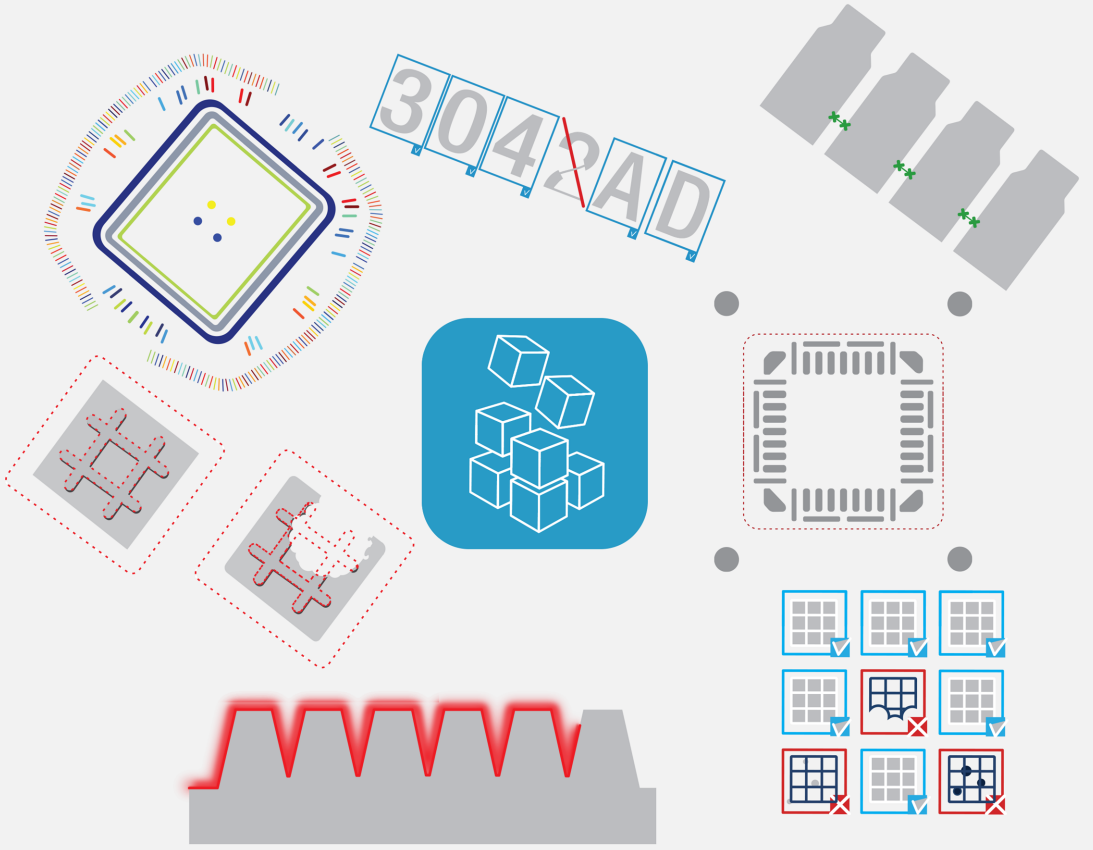
USER GUIDE

Open eVision

Easy3D Compatibility with IDS Ensenso 3D Sensors



This documentation is provided with Open eVision 2.14.0 (doc build 1141).
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Easy3D Compatibility with IDS Ensenso 3D Sensors

Introduction

The **IDS Ensenso** sensors are active stereo cameras for industrial applications.

The specifications are available on the manufacturer website:
https://en.ids-imaging.com/ensenso-stereo-3d-camera.html

- This document explains how to use the 3D data coming from these sensors with **Open eVision** 3D libraries and tools.
- A sample application distributed with source code demonstrates that integration. This application is freely available in the Easy3D Sensors Compatibility additional resources package on **Euresys** web site.

Resources

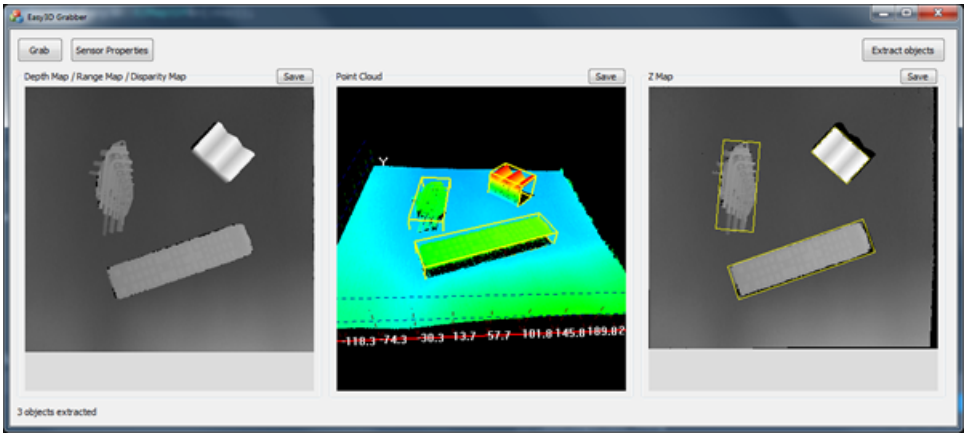
This document and the sample applications are based on the following resources:
- **Ensenso N35** device
- **Ensenso SDK** 3.0.275
- **Open eVision** 2.13
- Microsoft Visual Studio 2017

Features

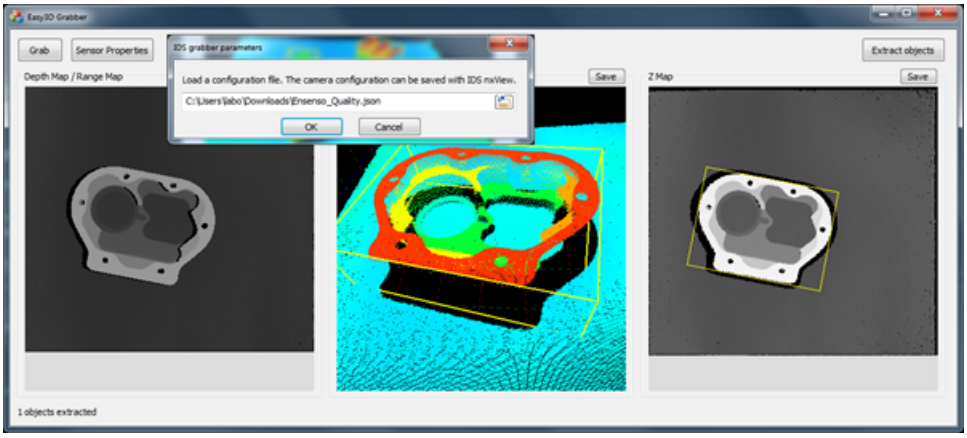
- The **Ensenso SDK** generates several depth outputs:
  - The raw and rectified images from the 2 cameras.
  - The disparity map as a 16-bit per pixel image.
  - The point map as three 32-bit float per pixel images.
  - The normal map as three 32-bit float per pixel images.
- The **Easy3DGrab** sample only uses and converts the disparity and the point maps.

Easy3DGrab sample application

Easy3DGrab is distributed with C++ source code as an **Open eVision** additional resource.
- It features the acquisition of **IDS Ensenso** range data, the conversion to depth maps, point clouds and ZMaps.
- You can save these representations.
- Click on the Grab button to acquire a new image.
- Open the Sensor Properties dialog to load a `JSON` configuration file generated by the **IDS nxView** application.
- The Object extraction function is exposed but you can use it only with the Easy3DObject license.



The Easy3DGrab application: EDepthMap (left), EPointCloud (center), EZMap (right) with automatic extraction of 3D objects with Easy3DObject library (yellow boxes)



The Sensor Properties button allows to load and apply a configuration file

C++ code sample to convert IDS Ensenso data to Easy3D objects

Converting a disparity map

You can generate `EDepthMap16` and `EPointCloud` objects from the disparity and point maps.

- The range of the disparity map is shifted to fit the unsigned short format of an `EDepthMap16`.
- The invalid pixels in the disparity map are marked with the value `0x8000` (`-32768`). You must translate them to `0`.

Here is the code snippet to fill an `Easy3D::EDepthMap16` object from a disparity map:

```
NxLibItem dispMap = camera[itmImages][itmDisparityMap];

int width, height;
dispMap.getBinaryDataInfo(&width, &height, 0, 0, 0, 0);

std::vector<int16_t> binaryData;
dispMap.getBinaryData(binaryData, 0);

// convert from signed short to unsigned short
// search for the minimum value
int d_min = 32767;
for (int i = 0; i < binaryData.size(); ++i)
{
  int16_t d = binaryData[i];
  if (d > -32768 && d < d_min)
    d_min = d; }

// Copy buffer to EDepthMap16
map.SetSize(width, height);

int i = 0;
for (int y = 0; y < height; ++y)
{
  uint16_t* dst = (uint16_t*)map.GetBufferPtr(0, y);

  // Copy disparity values to depth buffer z-values
  for (int x = 0; x < width; ++x, ++i)
  {
    int d = binaryData[i];

    if (d > -32768) // skip undefined pixel
      dst[x] = uint16_t(d - d_min);
    else
      dst[x] = 0;
  }
}
```

Converting a point map

A `PointMap` is a 3-channel image of 32-bit floats.

- Each pixel represents the 3 coordinates in millimeters with respect to the camera coordinate system (by default).
- The special float value `NaN` is used to mark invalid pixels.
- For consistency with other sensors, the Z and Y axis are reversed to refer the coordinates of the points to a "ground" origin, instead of a camera origin.

Here is the code snippet to fill an `Easy3D::EPointCloud` object from a `PointMap`:

```
// This converts the disparity map into XYZ data for each pixel
NxLibCommand(cmdComputePointMap).execute();

// Get info about the computed point map and copy it into a std::vector
int width, height;
camera[itmImages][itmPointMap].getBinaryDataInfo(&width, &height, 0, 0, 0, 0);

std::vector<float> pointMap;
camera[itmImages][itmPointMap].getBinaryData(pointMap, 0);

int size = width * height;

// Push valid 3D points to an EPointCloud
// with coordinate system flipping

std::vector<Easy3D::E3DPoint> pts;
pts.reserve(size);
float max = -1.0f;

Easy3D::E3DPoint p;
for (int i = 0; i < size; ++i)
{
  p.X = pointMap[3 * i];
  if (!std::isnan(p.X))
  {
    p.Y = height - pointMap[3 * i + 1];
    p.Z = pointMap[3 * i + 2];

    pts.push_back(p);
    if (p.Z > max)
      max = p.Z;
  }
}

for (int i = 0; i < pts.size(); ++i)
  pts[i].Z = max - pts[i].Z;

// Update the point cloud
point_cloud.Clear();
point_cloud.AddPoints(pts);
```

ZMap

- You cannot generate a ZMap (a gray scale image encoding distance from a reference plane, also called an orthographic projection of the point cloud) directly from **IDS Ensenso SDK**.
- Generate a ZMap from the point cloud with the `Easy3D::EPointCloudToZMapConverter` class.

TIP
The sample application **Easy3DGrab** implement the `EDepthMap16`, `EPointCloud` and `EZMap` conversions.