



**Evolving visions** 



### Automatic real-time 3D Microscope

based on

VisionSystems Control Control

**3D Stereo Vision** 

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## **3D Stereo Vision - How it works?**

**3D Stereo Vision** requires at least two "images" taken captured at the same time.

• the 3D pose of objects or features are calculated using the pose and pointing direction of the cameras.



#### How it works

The pose of the two cameras must be known in 3D - x,y,z and rx,ry,rz.

- A **3D calibration** of a camera **produce** the **position of the camera** or the extrinsics
  - in addition to the **intrinsics** which **describe the camera and including lens distortion**.

The images captured contains disparity information between the cameras **for every pixel** in the two images.

This information can be used to calculate the **3D position of any feature or object** visible in both images or a

• **dense 3D image** of the scene.





# **Optimal 3D Camera Calibration**

#### One micrometer resolution

- The Scorpion 3D Venom Camera is calibrated using a three step process
  - Using one 2D image pr camera to estimate
    - Estimating 2D lens distortion typical accuracy 1/20th of a pixel
    - One image pr camera

#### Using a 3D Calibration object

- One image pr camera
- Provides an initial guess for extrinsics and intrinsic
- Automatic 3D Calibration Process
  - Improves the calibration 5 to 15 x
- This provides the highest possible accuracy for 3D Venom









# **Company Profile**

- Tordivel is located in Oslo, Norway
  - Founded by Thor Vollset in 1992
  - $\circ$   $\,$  Scorpion Vision Ltd in UK since 2005  $\,$
- 23 years experience in 2D and 3D machine vision
  - Continuous innovation and development through projects and R&D
  - Excellence in 3D Stereo Vision
- Homemarket
  - Norway, Sweden, Germany and United Kingdom
- Software, hardware, components, optical setup and 2D and 3D OEM Solutions
  - Industrial 2D and 3D Cameras
- Machine Vision Solutions in Home Markets
- Global Distribution in 20 countries



**3D Assemby Verification** 







### **Scorpion 3D Stinger Technology**

Software and hardware that works together

#### • Scorpion Vision Software - 2D and 3D

• Based on Industry Standards

### Integrated Python scripting

- Support for OpenCV 4.1
- First version in 2000 now version XV
- Build # 750 8500 licences sold

#### • Scorpion Stinger Industrial Cameras

- Scorpion 2D and 3D Box Cameras
- Scorpion 2D and 3D Stinger Cameras
- Scorpion 3D Scanner 3000 fps
- Scorpion 3D Venom Camera
  - High resolution up 20 MBytes
  - Integrated white and IR LED illumination
  - Integrated encoder and camera sync
  - Support powerful IR laser projectors
- Factory calibrated and custom made





3D Code reading using Scorpion Neural OCR





## Scorpion 3D Venom - 20 mm baseline

- Single Camera baseline 20 mm Global Shutter 3D
- FOV 30 x 30 mm Working distance 120 mm
- Resolution from 0.001 mm Realtime cycle 10 20 fps
- Low-cost no projector laser target OEM





Scorpion 3D Venom Camera







## **Global Shutter 3D Camera**

Capture 3D images on the FLY moving just like a 2D Area Scan camera

- No speed limitation from 0 to 1000 m/s
  - Using strobing to freeze the image

### Accurate 3D measurement - from 0.001 mm

- Independent of object movement
- 100% Automatic Optical Inspection

### Measure thickness with two 3D cameras

- The pose of each camera is known
  - pose is x,y,z rx,ry,rz
- In 3D thickness is a simple subtraction between two camera

### You cannot always see it all from one side







### What is 2D?

### Matrix of intensity values - typical 1280 x 1024 pixels



This is an aluminium bar - What can you do? Measure width and length - say something useful based upon intensity variations. Not easy @ all ....







### What is 3D?

It is both 2D and 3D also it is a pretty image with true colors :)





#### The Field of View is 150 x 100 mm depth 75 mm resolution is 0.01 mm It is fast - image generation is typical 200 ms





TORDIVFI



### What is 3D?

It is maybe 4D - x,y,z and intensity



What can you do? Find the top plane and look for surface defects and height variations We see the red indent - 5 mm deep - find and describe the edges Much easier than 2D :)







### What is 3D?

It is really 4D - x,y,z and intensity



#### What can you do? Robust 3D measurements after object location Continuous 3D scanning on a moving conveyor 0.25 to 5.0 m/s







## **3D Microscope - Circuit board**

**Automatic 3D Assembly Verification** 

- Camera is 3D calibrated
  - works in mm @ any distance
  - calibrated once and for all :)
- Working area demo setup
  - o 80 x 80 mm
  - optical resolution 0.01 mm
- Scorpion 3D Venom can be installed in confined space
- Verify pin height before soldering
  - > 0.5 mm OK
  - > 2.0 mm OK
- Global Shutter 3D Camera
  - $\circ$  works on moving objects









### The 3Dpose of a pin is given by the disparity

The accuracy is defined by the resolution and the calibration accuracy



#### High resolution cameras and calibration down to 0.01 - 0.001 mm provides an edge







## **3D Assembly Verification**

Measuring pin presence including height

#### Nominal values are:

- Upper pins 1.0 mm OK
  1.4, 1.7 and 1.0 mm
- Lower pins 2.5 mm OK
  2.7, 2.8 and 2.8 mm

#### Repeatability : 0.15 mm

• 1.0 mm - 0.8 - 1.2 mm







Swedes

**Sprouts** 

Image2

Leeks



## **3D** Images for Foodtech



(2.983 -16.91) 7 192341-XYZWVf

· ·

||X X|| ||Y Y|| ||Z Z|| |⊖ ,⊕

1 1 2 ?

Dense

THE DOLL NO.

1090x1090-32 bit

90x1090-32 bit

•

**Only imagination** 





### Accurate leek cutting with 3D Images



### Only imagination sets the limits for real-time 3D vision





### **Sprout Cutting with 3D Images**

Advantages in 3D sprout segmentation and stem location



### **Real-time foodtech application in action**





### **Scorpion 3D Venom Camera** is a true innovation in 3D Machine Vision

Tordivel has been a supplier of 2D and 3D Machine Vision since 2001

**Experts in 3D Stereo Vision** Help you choose feature based or 3D dense image

Tordivel has developed best practices for 3D Machine Vision - **One Push 3D Calibration** and multiple camera alignment securing optimal accuracy and operation



### Tordivel deploys the next generation 3D Vision systems based on ultra flexible and proven Scorpion 3D Stinger Technology for OEMs



SL-2019-0003-A Real-time 3D Microscope Based on 3D Stereo Vision © Tordivel AS 2000-2018 Scorpion Vision Software and Scorpion Stinger are trademarks of Tordivel AS





### More information - Scorpion 3D Vision

- Tordivel AS <u>www.tordivel.no</u>
  - Thor Vollset <u>thor@tordivel.no</u>
- TordivelBlog <u>http://www.tordivelblog.com</u>
- YouTube TordivelBlog channel
  - <u>http://www.youtube.com/tordivelblog</u>

• UK Distributor : Scorpion Vision Ltd

