

HALCON 20.11新特性介绍

北京技术中心

中国大恒(集团)有限公司北京图像视觉技术分公司
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会议日程

15:00-15:02	开场白
15:02-15:50	HALCON 20.11新特性解读
15:50-15:58	现场答疑
15:58-16:00	结束语

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- 基于形状的匹配技术改进
- 支持DotCode
- 深度学习OCR
- 深度学习边缘提取
- 深度学习模型剪枝
- 基于表面的匹配技术改进
- 引入Python接口

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- HDevelop Facelift
- 支持Markdown编写程序文档
- 减少基于形状匹配的中间内存
- 3D重构技术改进
- 更多新特性
- MVTec软件管理器早鸟版

基于形状匹配的 技术改进

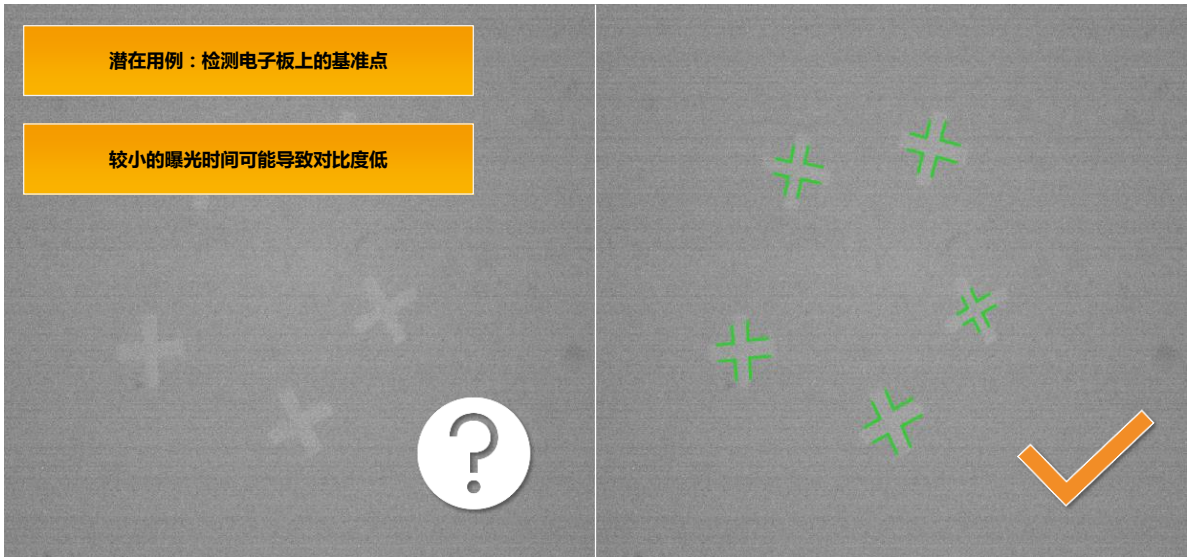


基于形状的匹配现在在挑战性场景中表现更好

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潜在用例：检测电子板上的基准点

较小的曝光时间可能导致对比度低

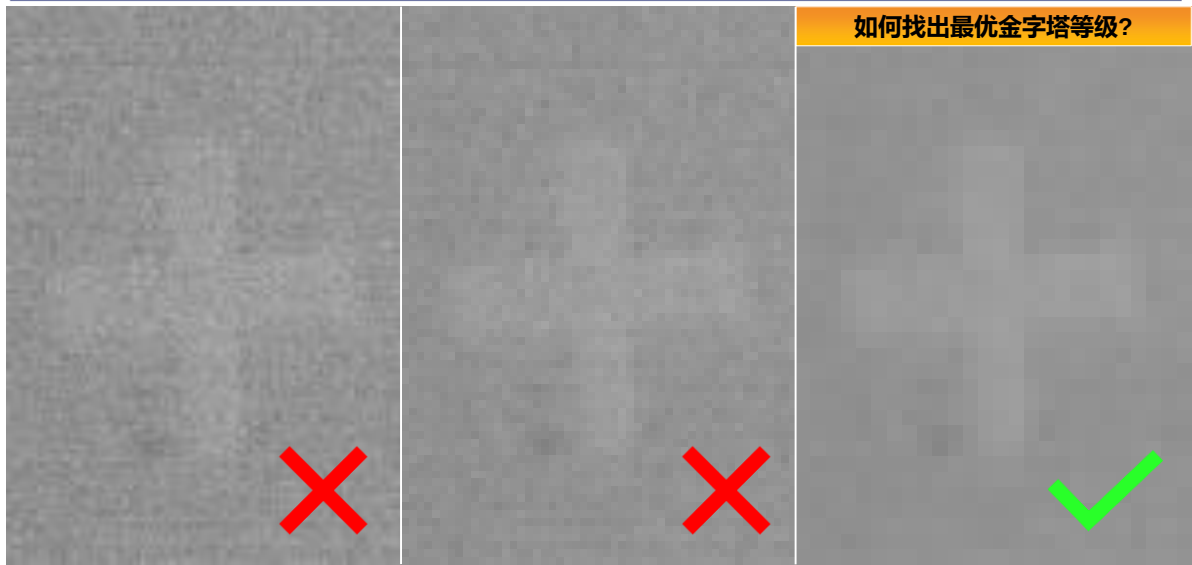


在更高金字塔级别上找到更多匹配项

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级别越高，噪声的影响越小

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使用adapt_shape_model_high_noise调整NumLevels

```
adapt_shape_model_high_noise (
```

```
  ◀ ImageReduced ::
```

```
  ◀ ModelID,
```

```
  ◀ GenParam :
```

```
  ◀ ResultDict )
```

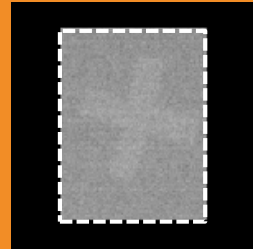


Image reduced to an instance to find

GenParam = 'lowest_level'

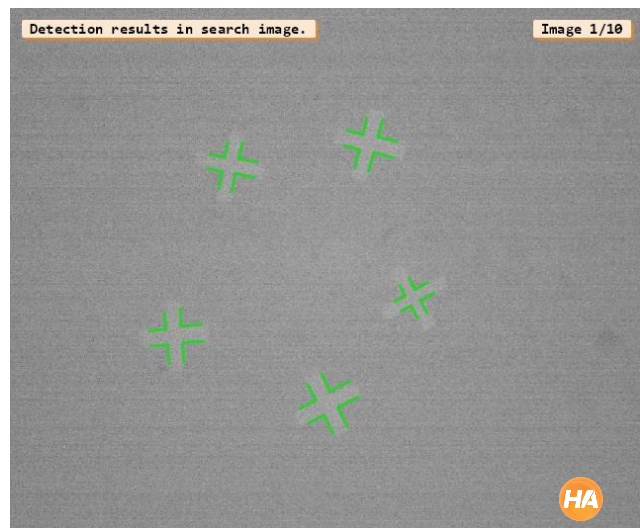
估计最低金字塔等级

Handle Inspect: ModelID	
Keys	Values
ModelID	H104020E11B0 shape_model)
NumLevels	[3, 0]
AngleStart	0.000757
AngleExtent	1.80551

adapt_shape_model_high_noise
'lowest_level'

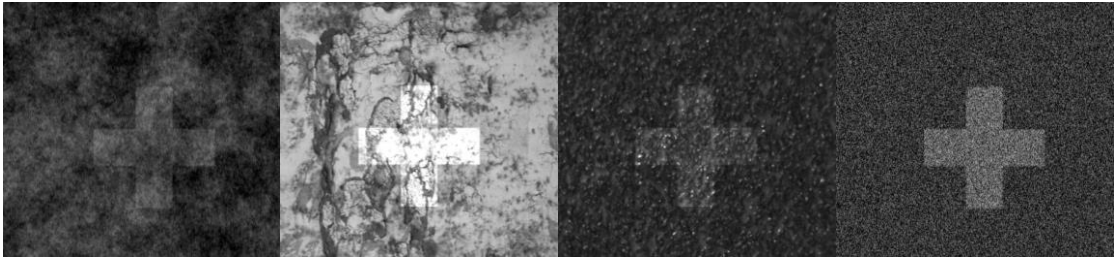
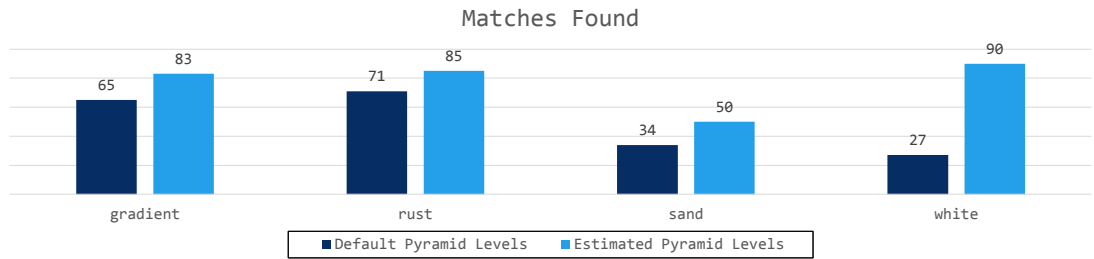
Handle Inspect: ModelID	
Keys	Values
ModelID	H104020E11B0 shape_model)
NumLevels	[3, 3]
AngleStart	0.000757
AngleExtent	1.80551

现在，可以正确找到所有匹配项，估计的最低金字塔等级为3。



对不同噪声类型进行基准测试可得到更好的结果

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支持DotCode

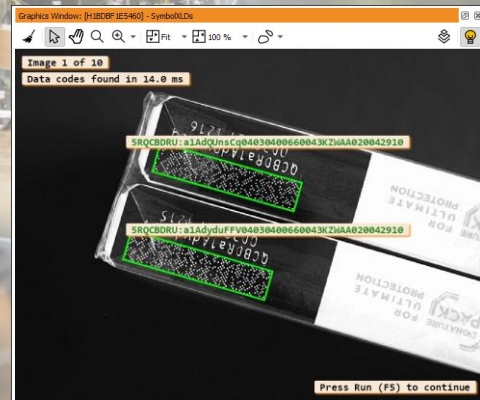


HALCON的二维码读取器现在支持DotCode

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DotCode可以非常快速地打印

特别适用于高速应用



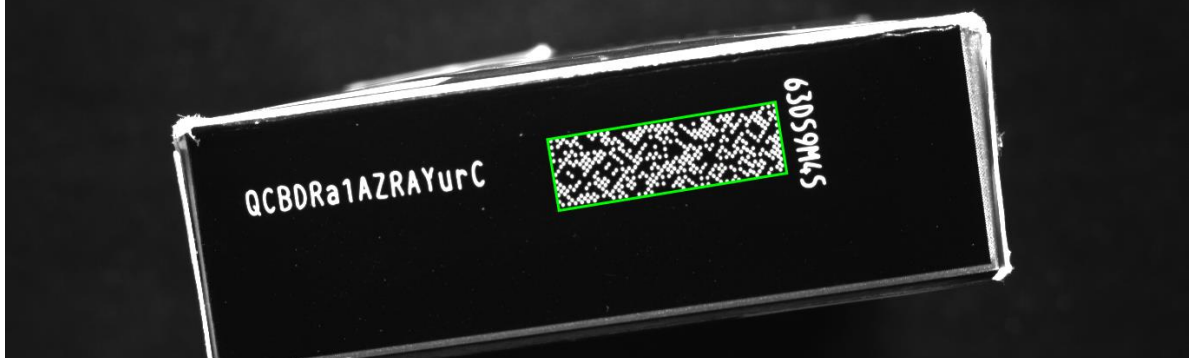
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DotCode读取器的工作方式与其他二维码读取器相同

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```
create_data_code_2d_model ('DotCode', [], [], DataCodeHandle)

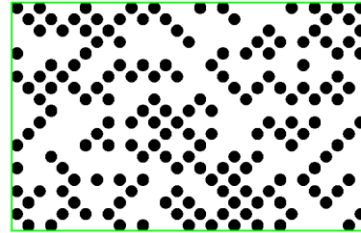
find_data_code_2d (Image, SymbolXLDs, DataCodeHandle, [], [], ResultHandles,
                  DecodedDataStrings)
```



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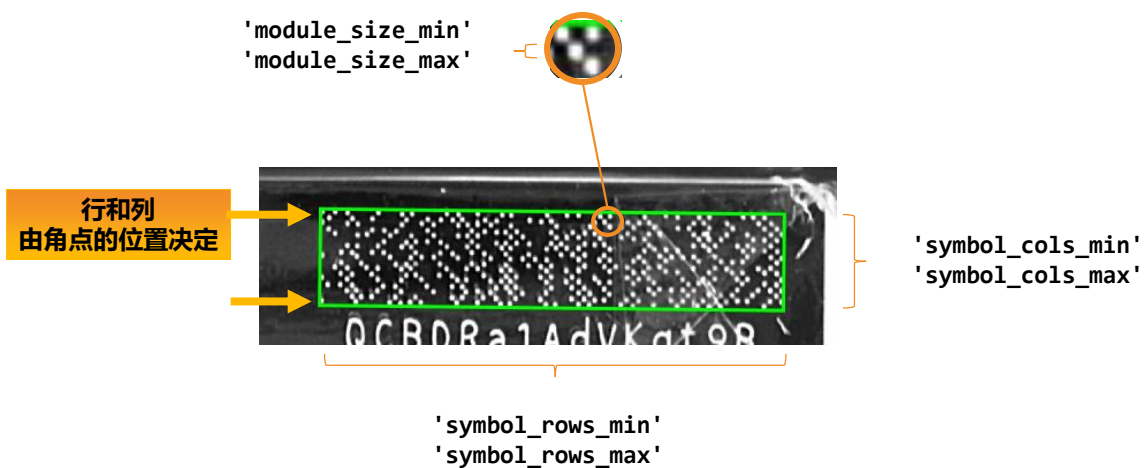
DotCode符号可以包括几部分单独的信息片段

```
get_data_code_2d_results( : :
  ▶ DataCodeHandle,
  ▶ ResultHandle,
  ▶ 'segment_num' or
    'decoded_string_separated' or
    'decoded_data_separated' or
    'symbology_ident_separated' or
    'structured_append_separated' or
    'reader_programming_separated' :
  ◀ ResultValues)
```

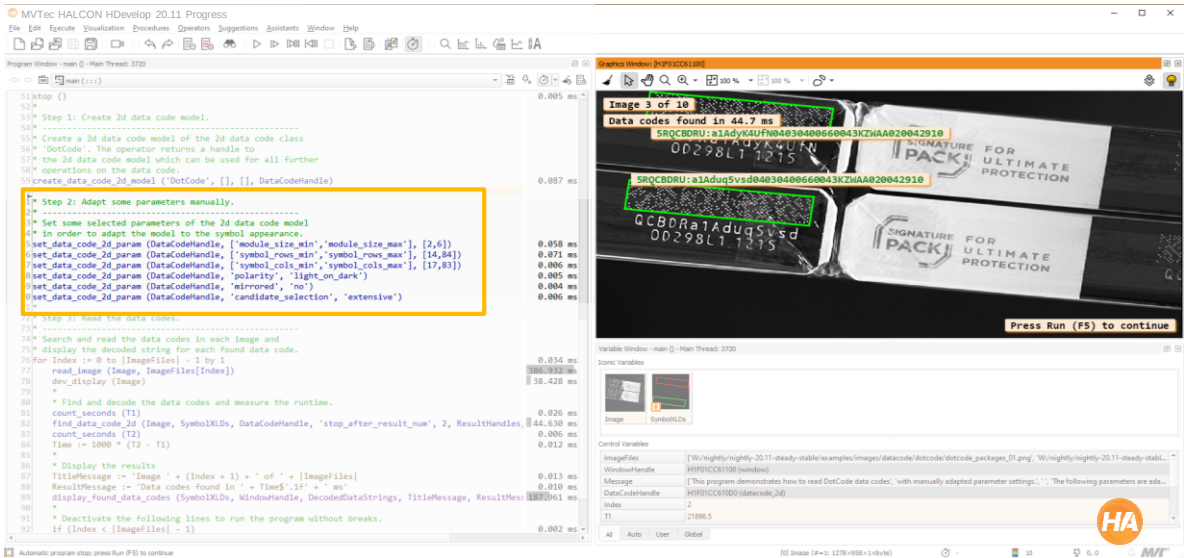


```
SegmentNum = 2
DecodedString = 'MVTec'
DecodedStringSeparated = ['MVTec', 'Software GmbH']
```

通过 set_data_code_2d_param 设置读码参数



Dotcode教程



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HALCON支持数据矩阵矩形扩展 (DMRE)

- DMRE符号是Data Matrix ECC 200的扩展
- ISO/IEC DIS 21471 添加 18 种新符号大小:

8 x [48, 64, 80, 96, 120, 144]
 12 x [64, 88]
 16 x 64
 20 x [36, 44, 64]
 22 x 48
 24 x [48, 64]
 26 x [40, 48, 64]

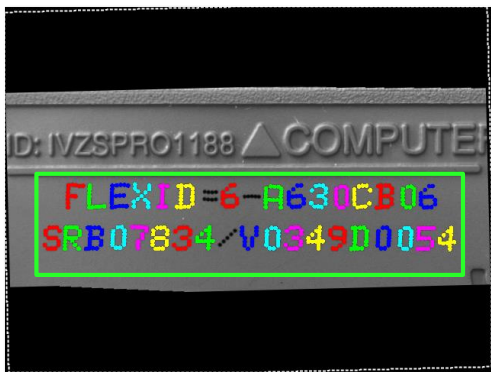


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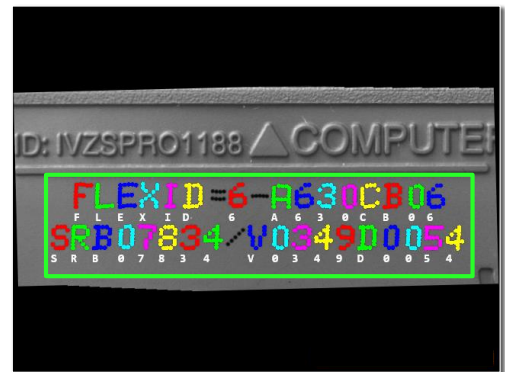


HALCON 13中的第一步: 基于深度学习的OCR识别

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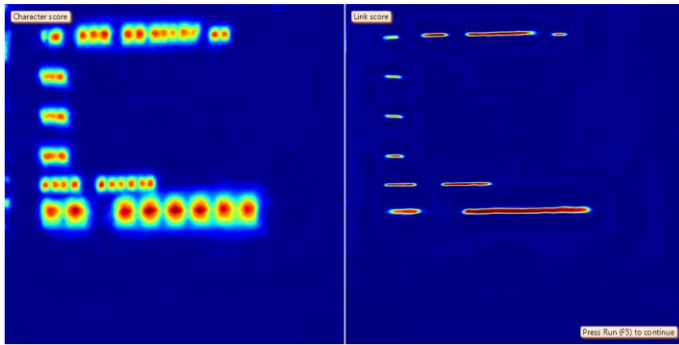
使用传统字符分割方法找到文本内容



使用基于深度学习方法训练好的字体识别
字符

下一层次: 深度OCR – 一种基于深度学习的整体方法

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使用深度学习检测文本

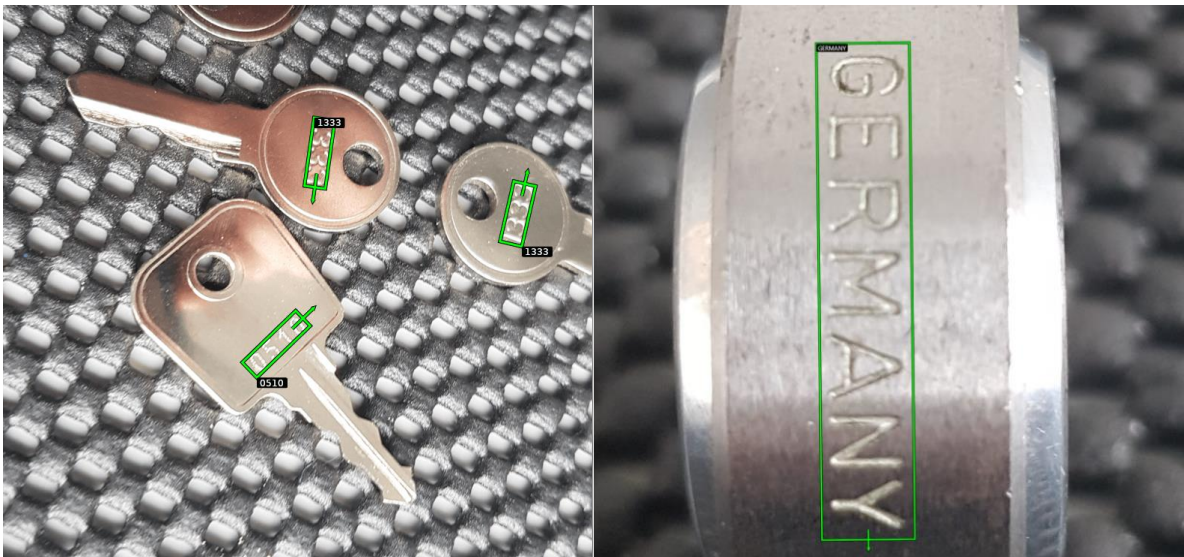


使用深度学习识别文本

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深度OCR：不受方向角度的限制

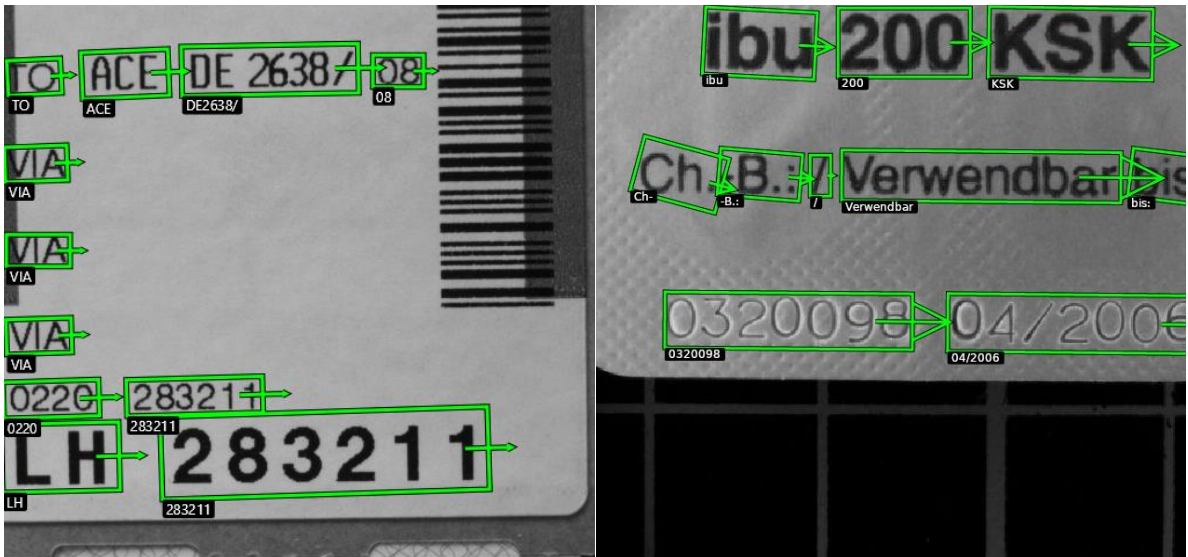
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深度OCR：同识别单词一样识别字符组

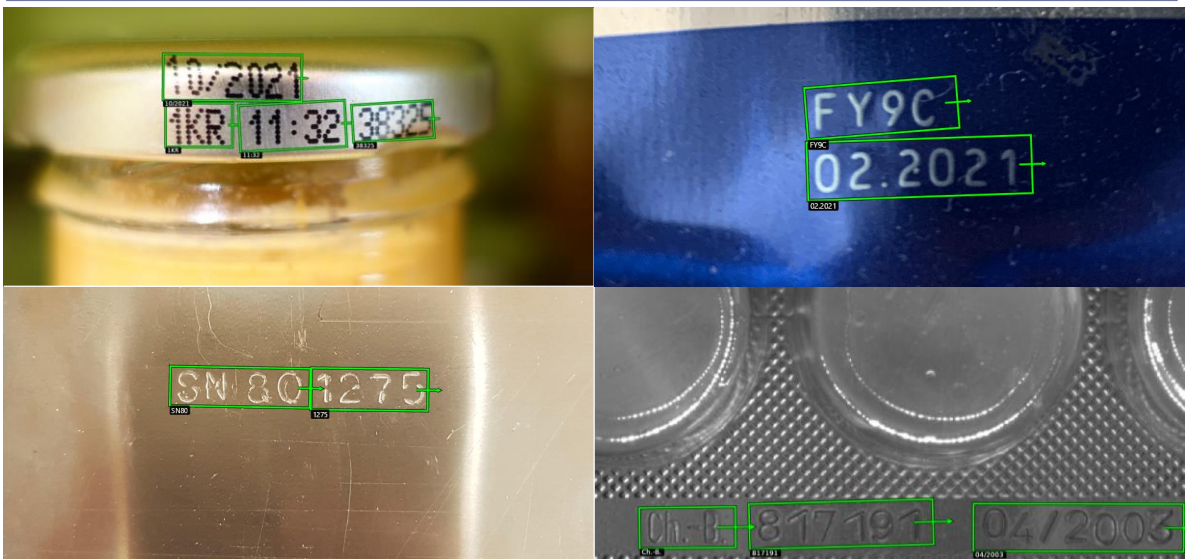
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深度OCR：不受字符类型的限制

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深度OCR需要配置合适的硬件环境

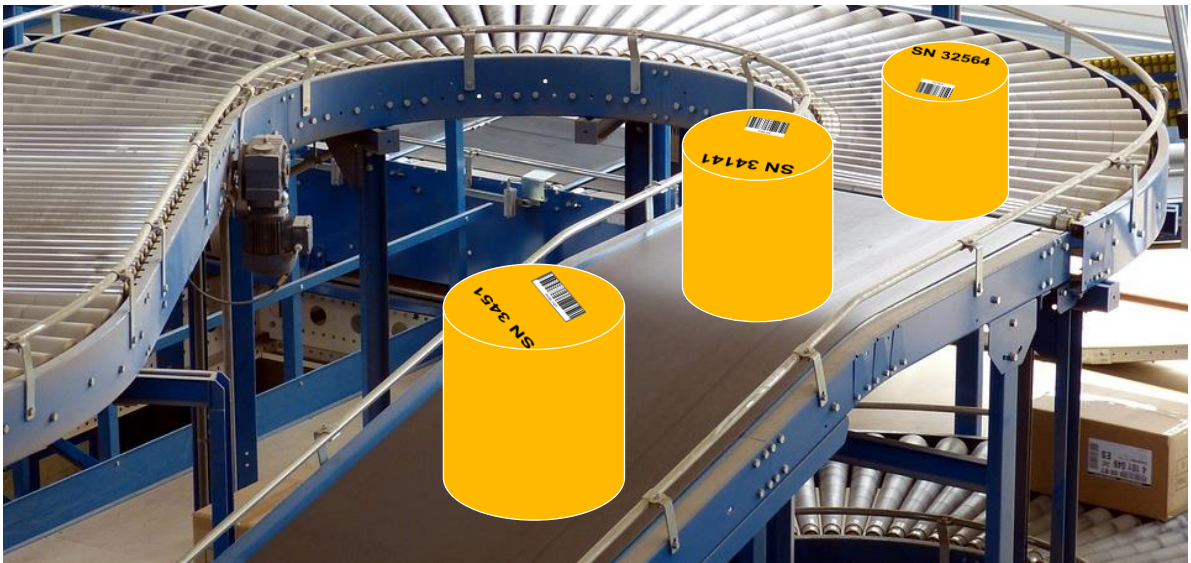
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Architecture	Runtime	apply_deep_ocr 'auto'		
		1024×1024	768×768	512×512
NVIDIA GTX 1080 Ti [16x Intel® Xeon® CPU E5-2637 v4 @3.50GHz]	GPU [ms]	93.0	70.6	39.8
NVIDIA RTX 2080 Ti [16x Intel® Xeon® CPU E5-2637 v4 @3.50GHz]	GPU [ms]	123.6	106.4	58.0
Intel® Core® CPU i9-10900X @3.70GHz Running 8 threads	CPU [ms]	408.6	236.5	102.8
NVIDIA Jetson TX2 [256-core NVIDIA Pascal™ GPU, 2x Denver2 + 4x Cortex-A57 CPU]	GPU [ms]	1948.3	1224.6	569.3

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利用文本位置的先验知识提高深度OCR的识别速度

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Architecture	Runtime	apply_deep_ocr 'auto'			apply_deep_ocr 'recognition'
		1024×1024	768×768	512×512	
NVIDIA GTX 1080 Ti [16x Intel® Xeon® CPU E5-2637 v4 @3.50GHz]	GPU [ms]	93.0	70.6	39.8	4.8
NVIDIA RTX 2080 Ti [16x Intel® Xeon® CPU E5-2637 v4 @3.50GHz]	GPU [ms]	123.6	106.4	58.0	9.8
Intel® Core® CPU i9-10900X @3.70GHz Running 8 threads	CPU [ms]	408.6	236.5	102.8	10.4
NVIDIA Jetson TX2 [256-core NVIDIA Pascal™ GPU, 2x Denver2 + 4x Cortex-A57 CPU]	GPU [ms]	1948.3	1224.6	569.3	51.6

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深度OCR是一个专门针对OCR预训练好的深度学习模型

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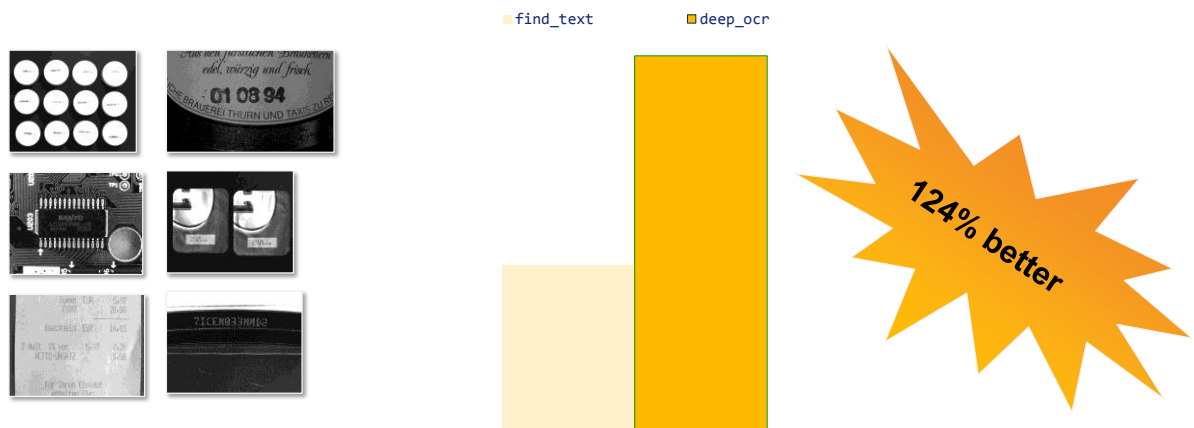
- ✓ 基于数万张图像样本
- ✓ 使用MVTec公司的内部数据进行预训练
- ✓ 不涉及侵犯版权

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深度OCR在具有挑战性的数据上表现优于find_text

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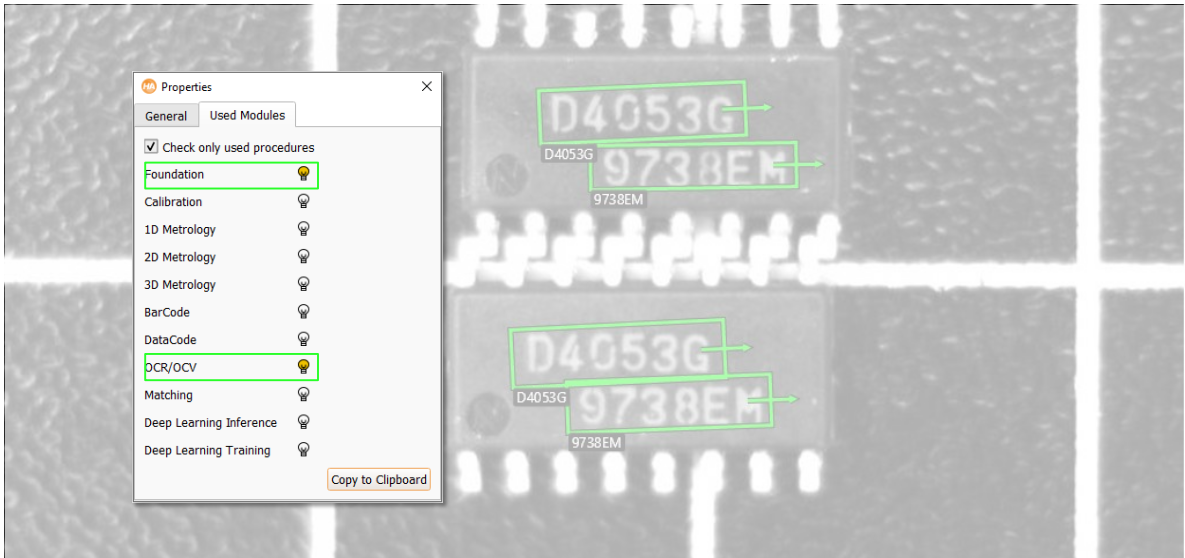
➤ 测试具有挑战性的内部数据集，包含来自工业场景的15k个单词



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深度OCR 只需要 OCR/OCV 许可

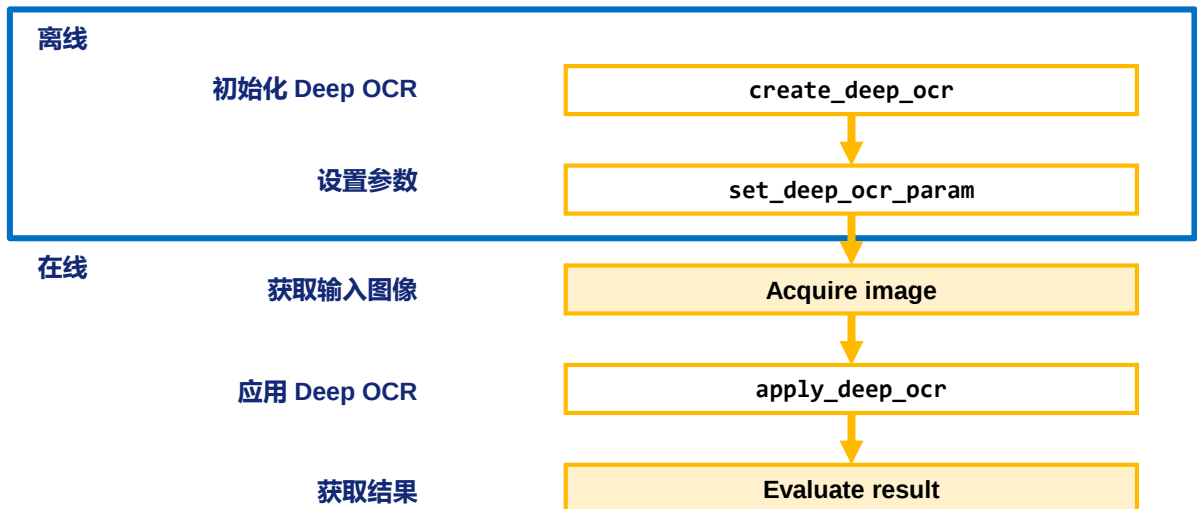
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深度OCR设置简单

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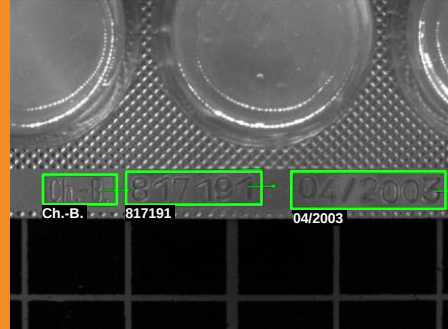
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一次调用即可获取图像中的所有文本行

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`apply_deep_ocr (`

- ▶ Image ::
- ▶ DeepOcrHandle,
- ▶ Mode :
- ◀ `DeepOcrResult`)



HDict 包含
Deep OCR 结果

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深度OCR 有三种运行模式

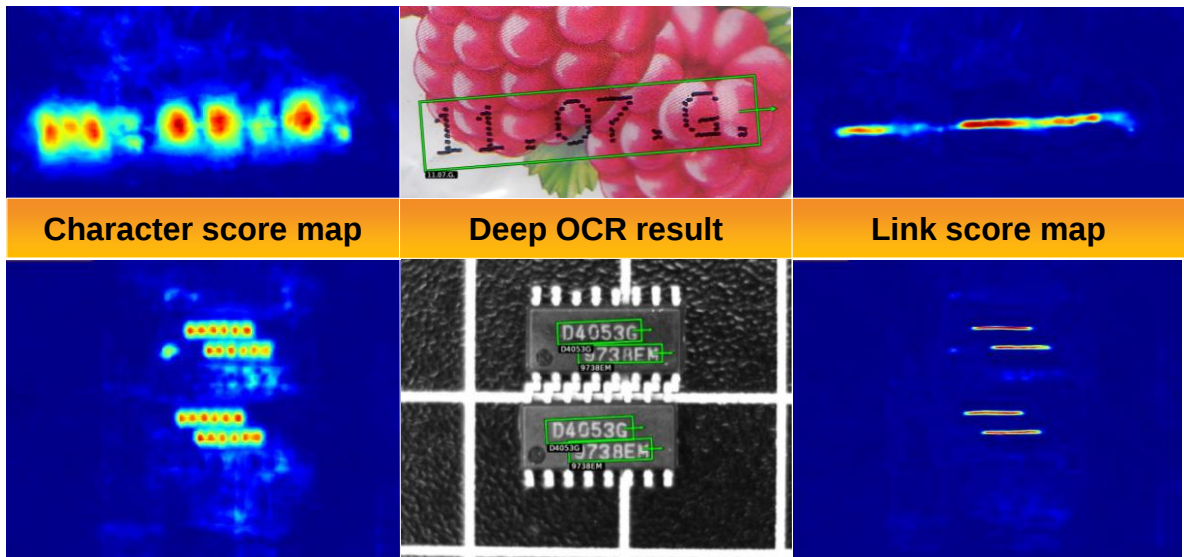
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'detection'	'recognition'	'auto'
仅定位字符区域	识别给定区域文本	定位和识别

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使用分数热图参数来优化结果

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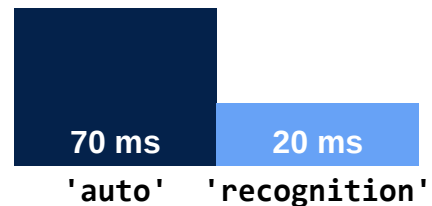
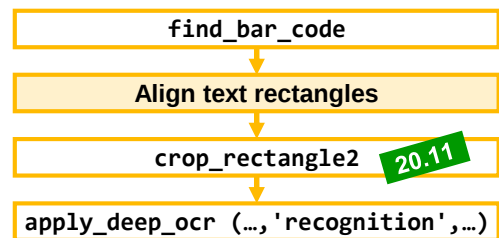
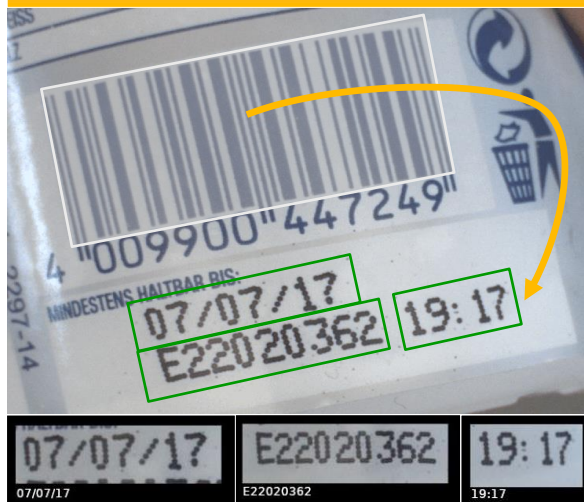


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在深度OCR 'recognition' 提高识别速度

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Text rectangle alignment and 'recognition' mode



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crop_rectangle2 裁剪带角度的矩形

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通常只需要输入图像的一小部分

crop_rectangle2



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裁剪方式选择

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```
crop_rectangle2 (
  ◀ Image :
  ▶ ImagePart :
  ◀ Row,
  ◀ Column,
  ◀ Phi,
  ◀ Length1,
  ◀ Length2,
  ◀ AlignToAxis,
  ◀ Interpolation : )
```

'true'



'false'



Zero padding

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使用set_deep_ocr_param调整深度OCR的输出结果

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```
set_deep_ocr_param ( : :  
    ▶ DeepOcrHandle,  
    ▶ GenParamName,  
    ▶ GenParamValue  
    : )
```

'detection_min_character_score'
'detection_min_link_score'
'detection_min_text_area'
'detection_min_word_score'

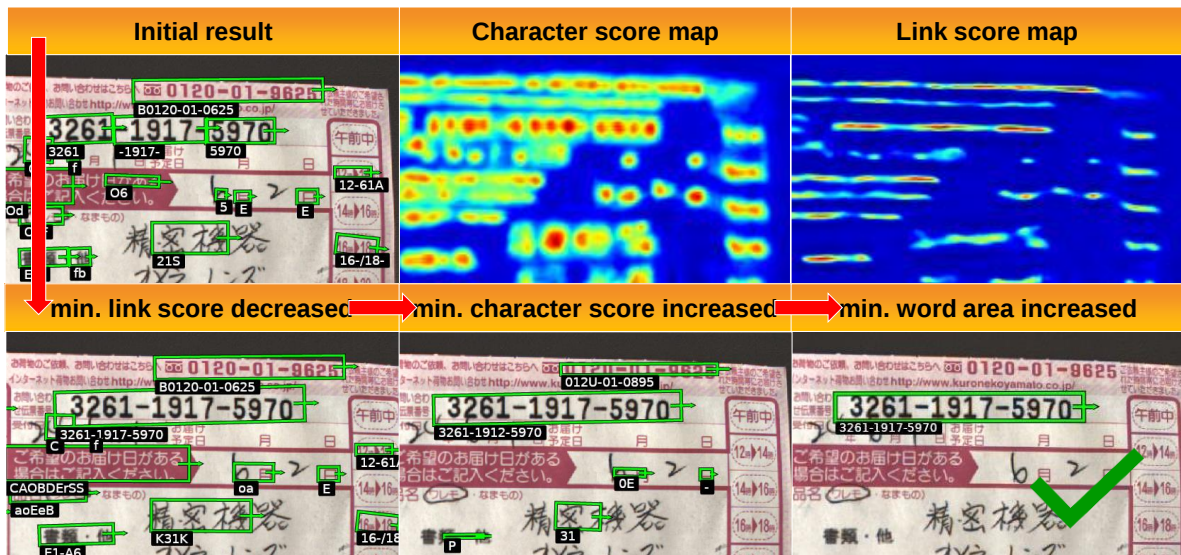


Parameters influence
the Deep OCR result

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调整深度OCR的参数来获得想要的结果

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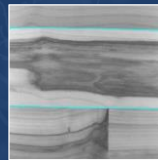
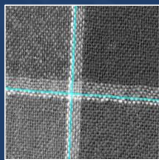


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HALCON强大的深度学习功能

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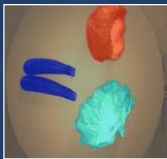
Edges



Decision + Pixels

深度学习边缘提取

异常值检测



Pixels

语义分割



Objects

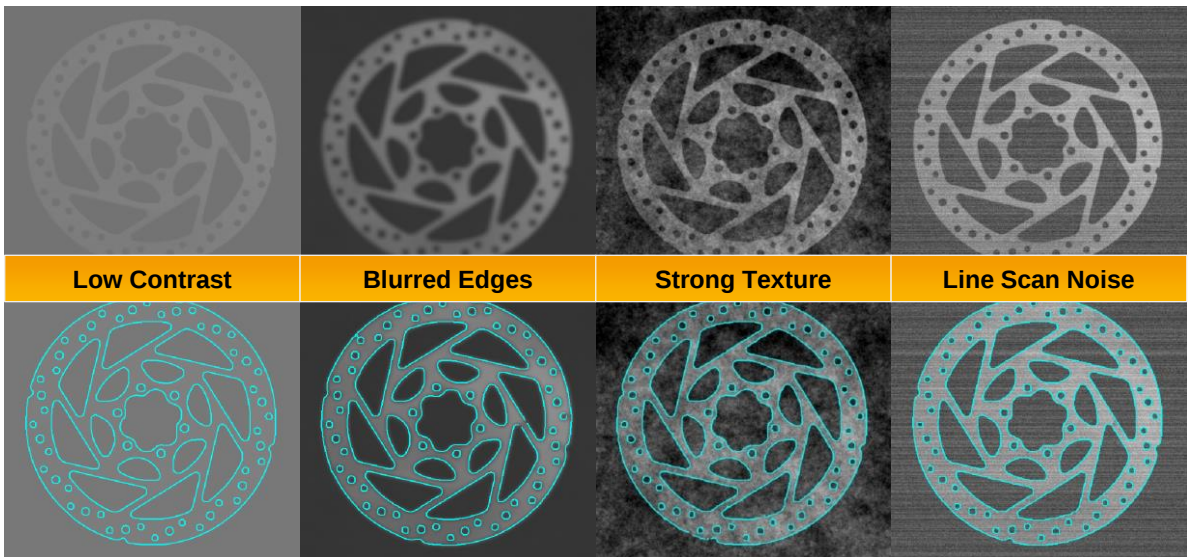
目标检测



Decision

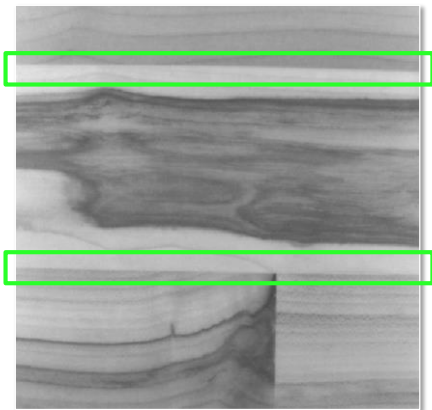
分类

预训练模型适用于复杂且具有挑战性的场景

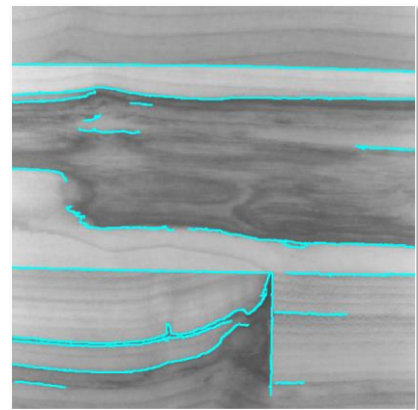
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在许多应用中只检测需要的边缘是比较困难的

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例子: 地板缝隙

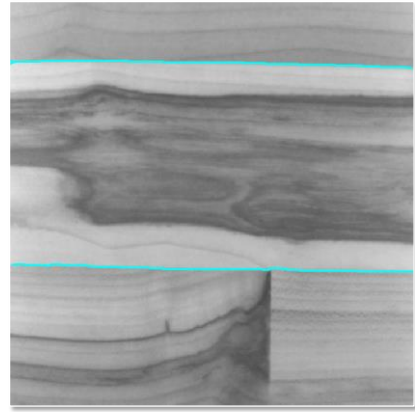
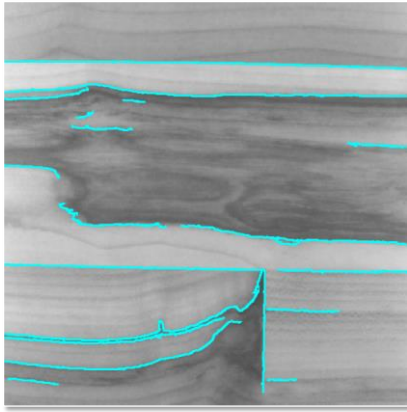


需要大量的后处理才能达到预期的结果

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深度学习边缘提取可以通过再训练获得更好的结果

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应用-具体训练模型

~10 标注图像



无需繁琐后续处理即可达到预期的效果

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深度学习边缘提取性能稳定

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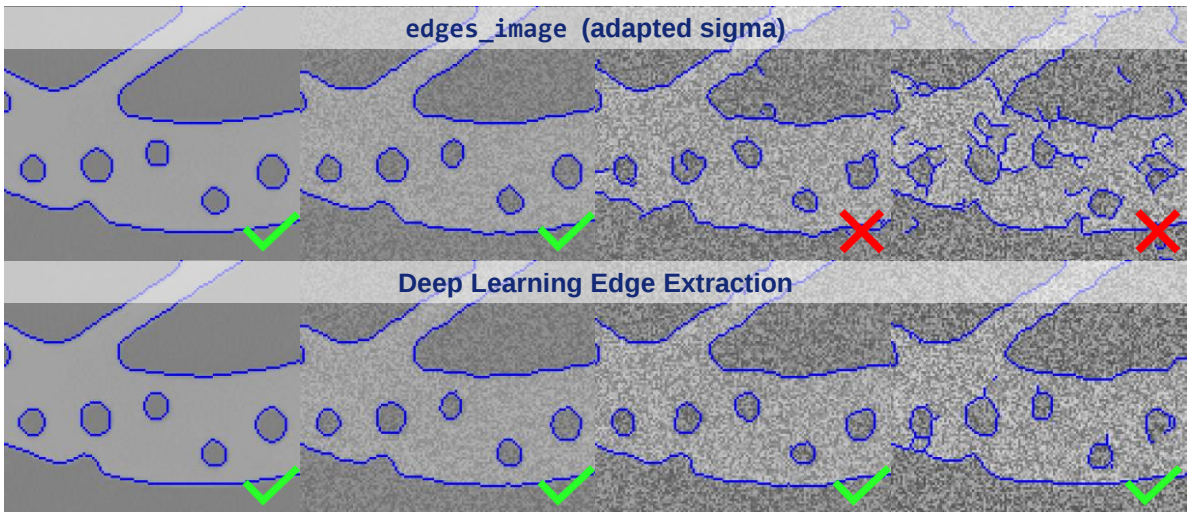
ImageNoise := 0

ImageNoise := 20

ImageNoise := 40

ImageNoise := 50

edges_image (adapted sigma)

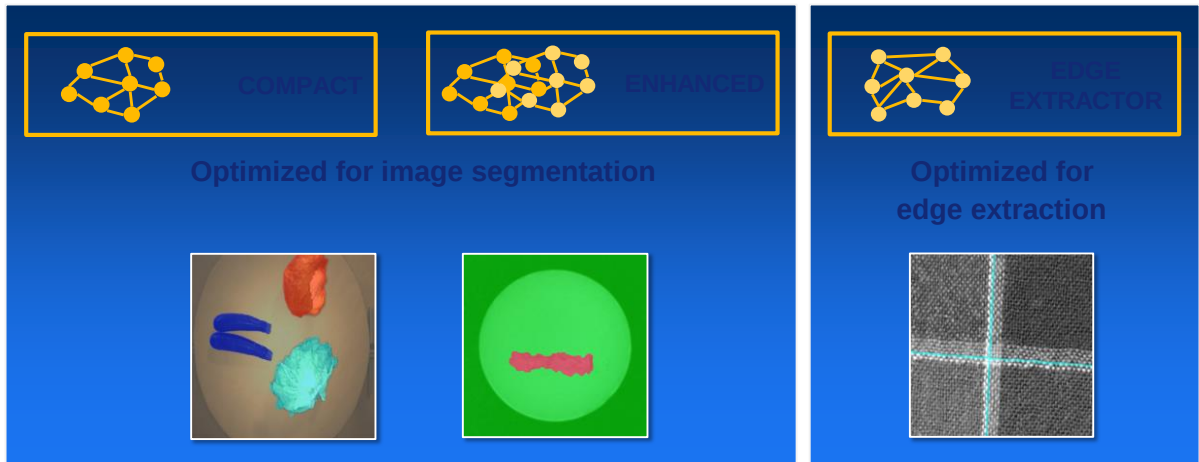


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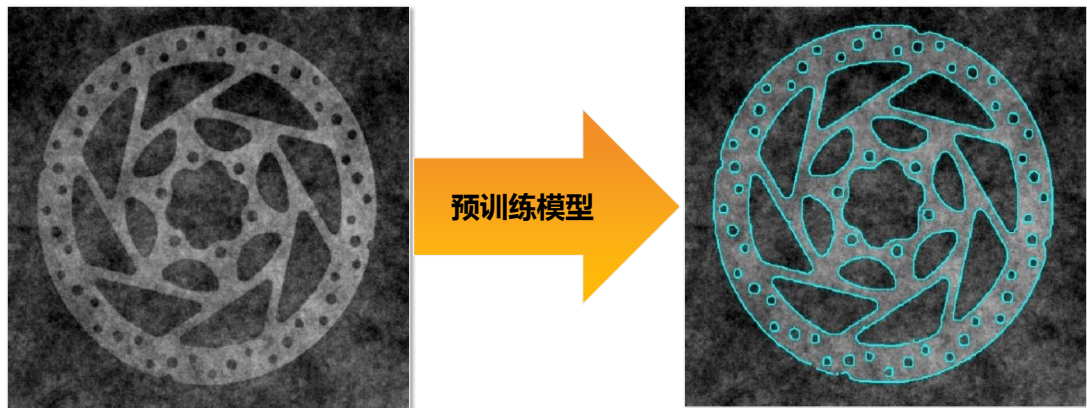
深度学习边缘提取基于语义分割

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预训练语义分割模型

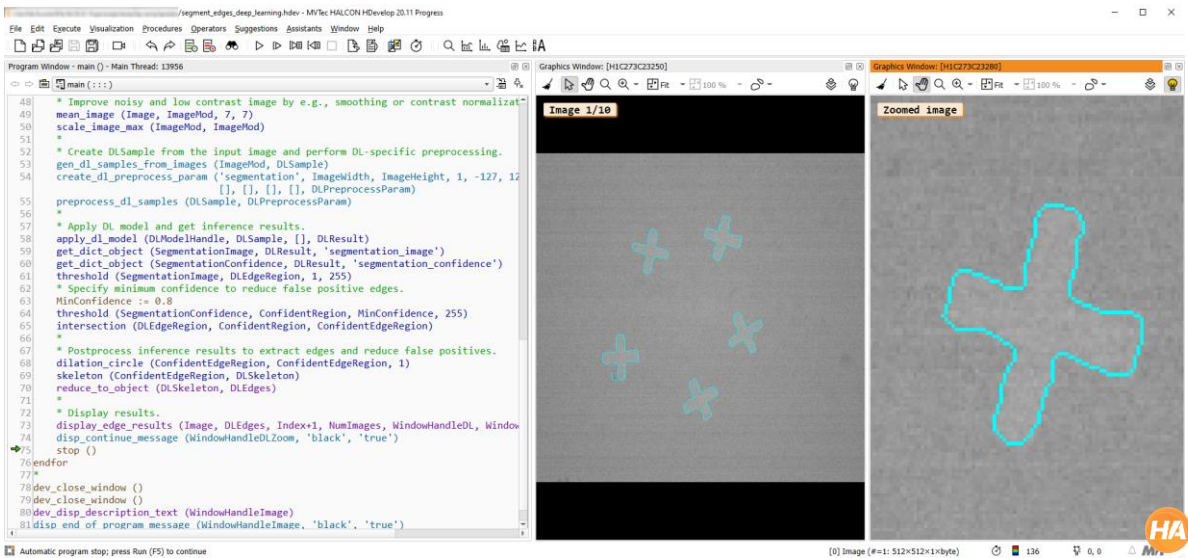
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深度学习边缘提取无需训练

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HALCON 提供参考示例

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深度学习边缘提取工作流程

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离线

读取 DL 网络

read_dl_model ('pretrained_dl_edge_extractor.hdl', ...)

设置参数

set_dl_model_param

在线

准备DL样本

gen_dl_samples_from_images

预处理样本

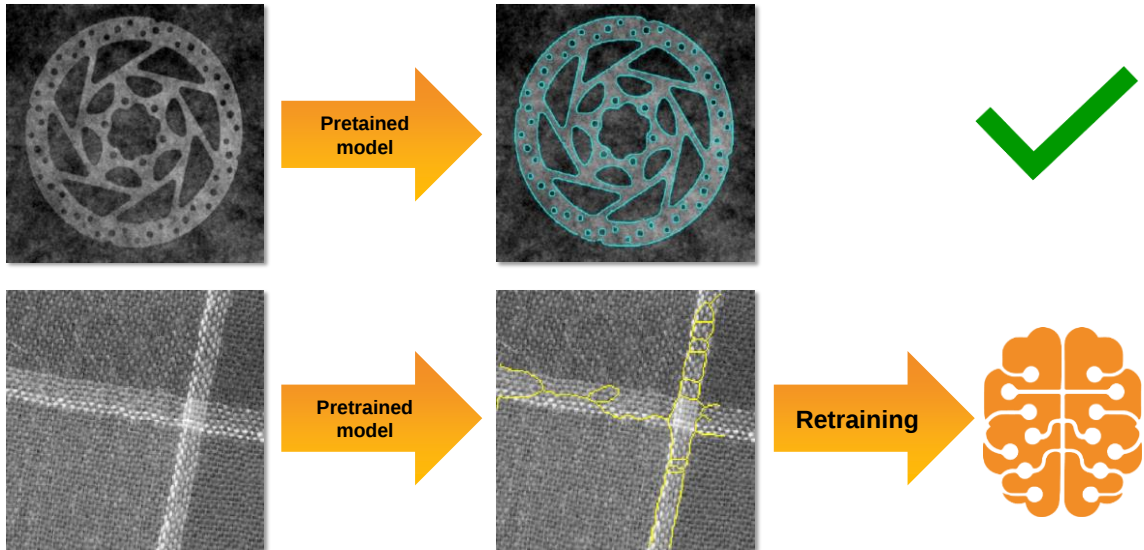
preprocess_dl_samples

执行边缘检测

apply_dl_model

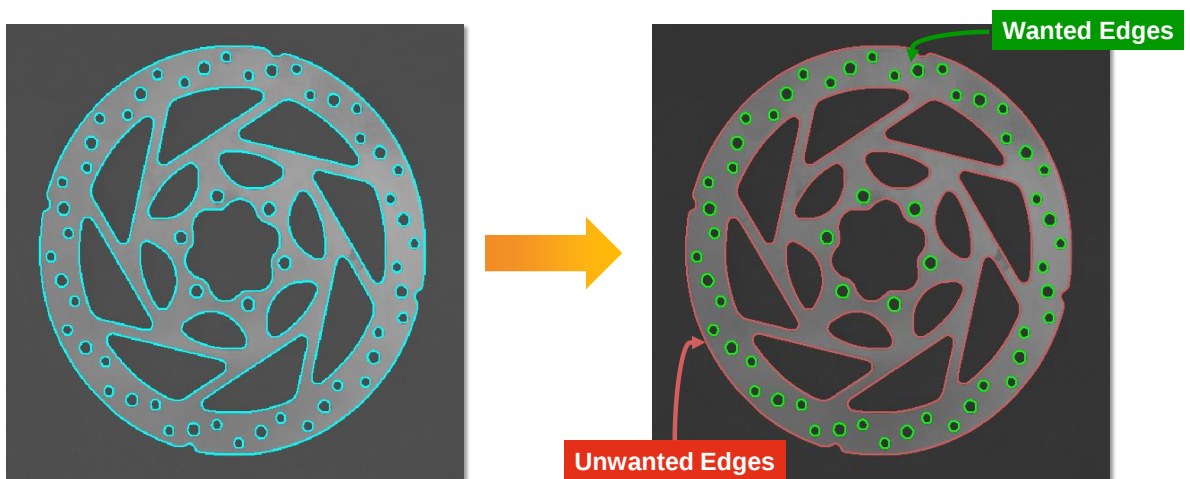
特定的边缘场景需要再训练

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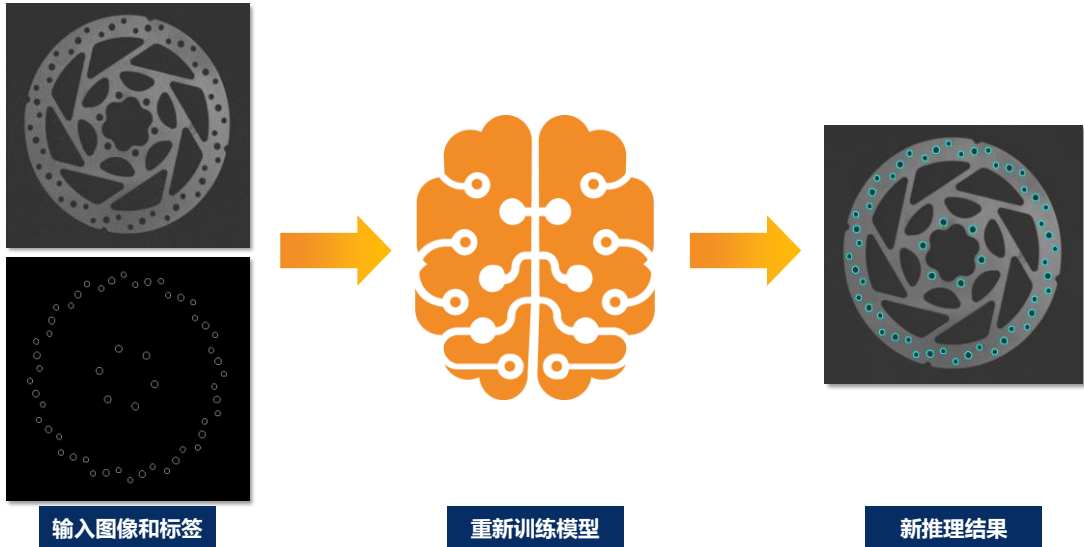
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再训练深度学习边缘提取模型

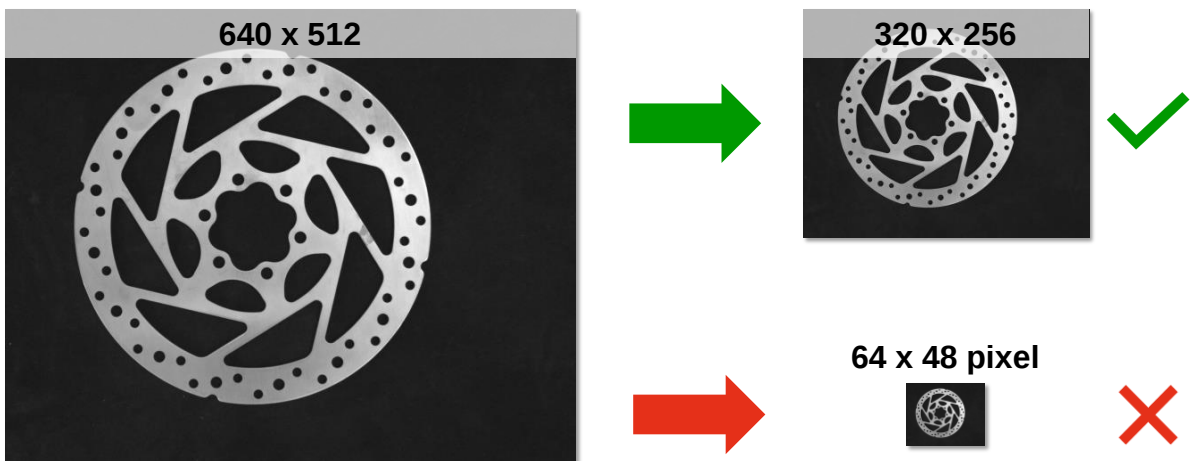
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再训练深度学习边缘提取模型

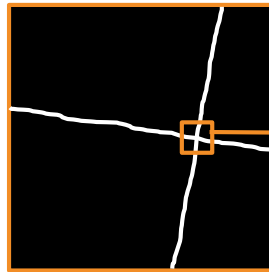
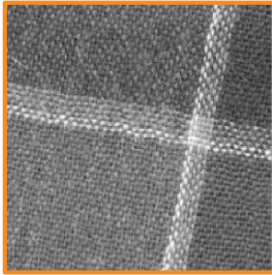
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在标记图像之前缩放图像尺寸

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标记数据用于训练

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0	0	0	0	1	0
1	0	0	0	1	0
0	1	1	1	0	0
0	0	1	1	1	0
0	0	1	0	0	1
0	1	0	0	0	0

Image

Ground Truth

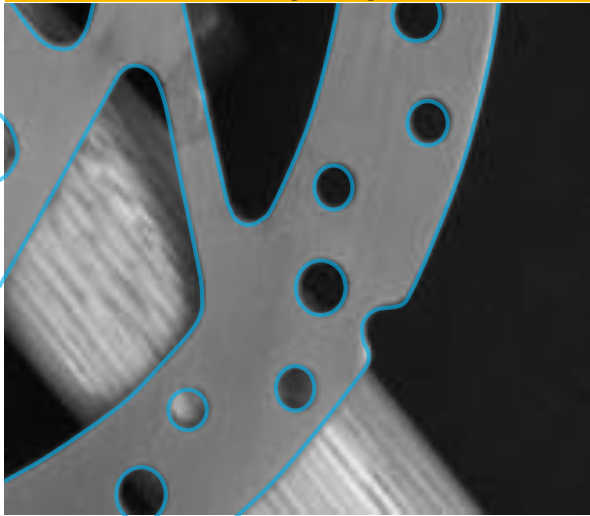
Class IDs:
0: background
1: edge

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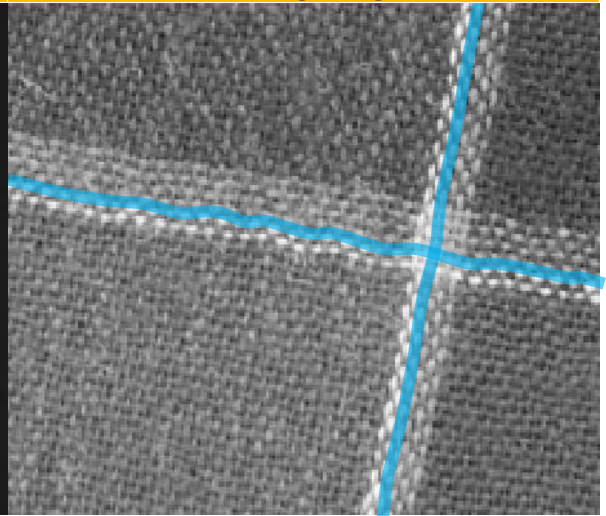
边缘区域应该有多宽?

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Thin edge region



Wide edge region



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HDevelop脚本标注程序

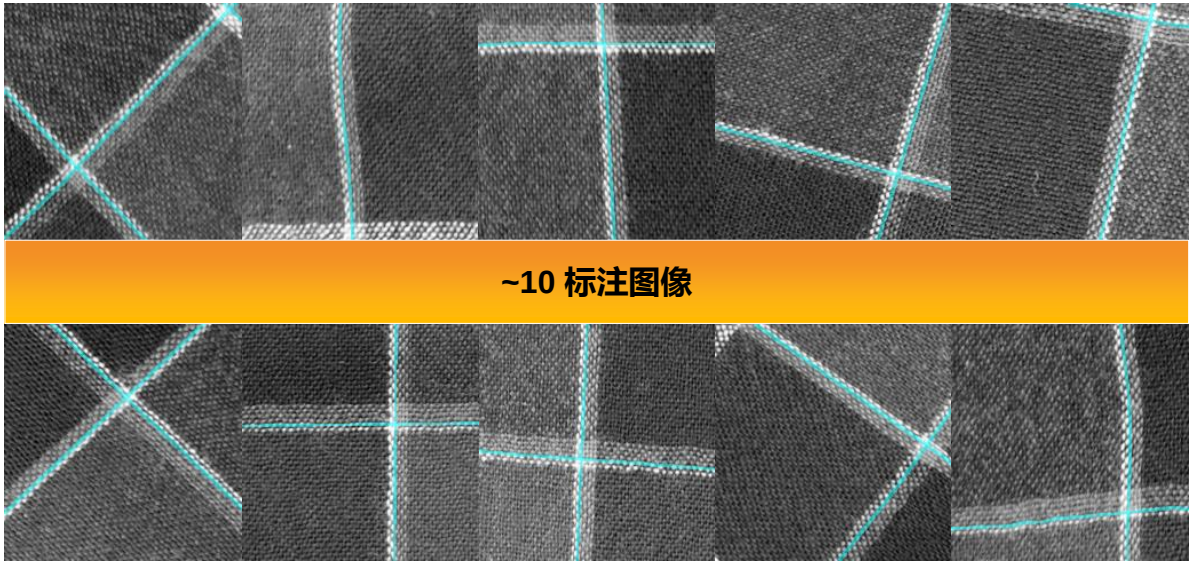
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The screenshot shows the HDevelop website interface. The top navigation bar includes 'Company', 'Products', 'Services & Support', and 'News & Press'. The 'Services & Support' section is expanded, showing a sidebar with 'Services', 'Support', 'Industries', and 'Technologies'. Under 'Technologies', 'Deep Learning' is selected, and 'How to Start' is highlighted. The main content area is titled 'How to Start' and describes the MVtec HALCON deep learning tool box. It mentions that the tool box contains everything needed for the entire deep learning process chain, from image acquisition to inference. It also mentions the MVtec Deep Learning Tool, a tool for labeling training data. A 'Workflow' section lists four steps: Preparation, Acquire, Label & review data, and Train. A small screenshot of the 'A screenshot of the Learning Tool' is shown. An orange banner at the bottom right of the screenshot reads 'HALCON 20.11发布后可获得' (Obtainable after HALCON 20.11 release).

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只需要少量的训练图像

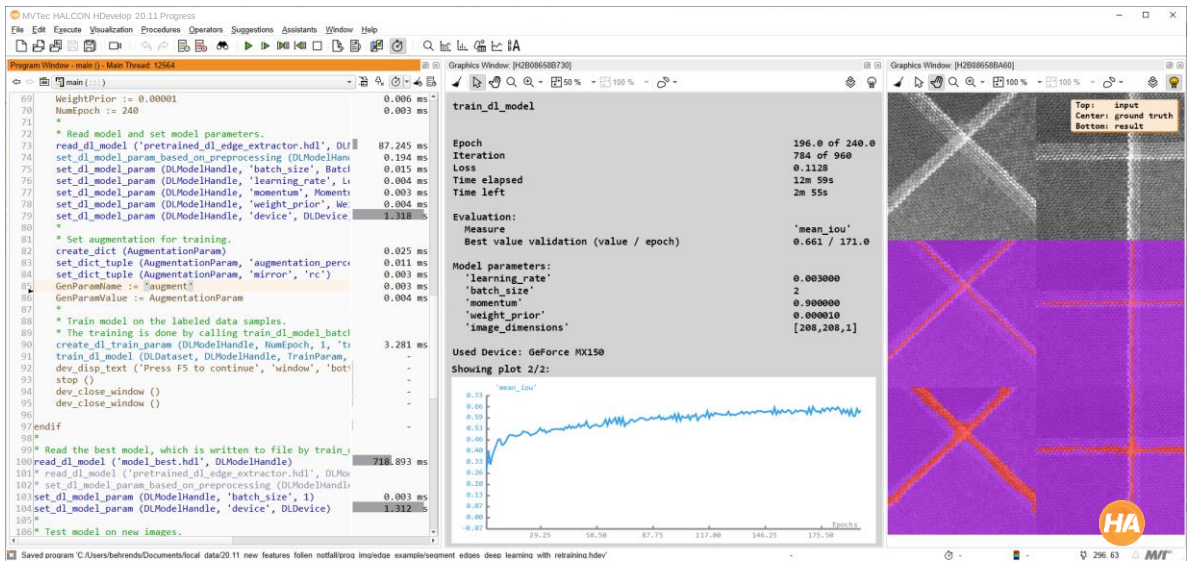
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HALCON 提供再训练模型的工作流程示例

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使用HALCON运算符将边缘区域转换为边缘线

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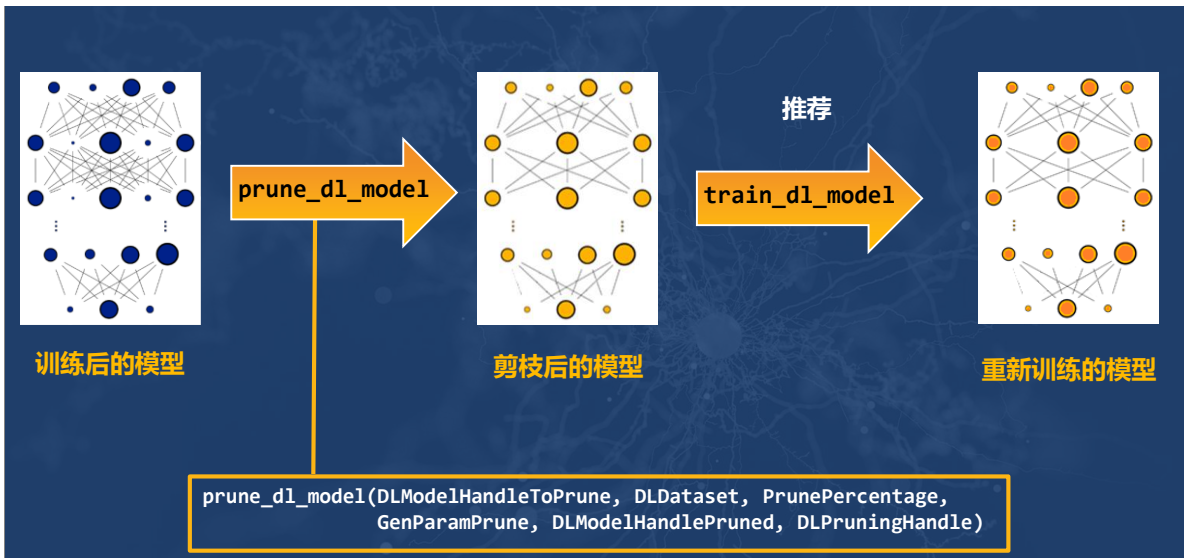
深度学习 模型剪枝

“剪枝”使网络更适合嵌入式应用

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深度学习分类模型剪枝的工作流程

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深度学习分类模型剪枝权衡

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[*] prune_dl_model_classification_workflow.hdev
 [**] Halcon Compact pre-trained network
 [***] PruningPercentage: 40%

	Classification result *, **, ***	
	Top1_error	f-score
TRAINED model	0.012	0.998
RETRAINED PRUNED model	0.028	0.972

	Exemplary Inference Times [ms]				File Size [MB]
	GPU: GTX 1080	CPU: - linux	CPU: armv7a -linux	CPU: aarch64-linux	
TRAINED model	1.5	5.8	288	122	2.9
RETRAINED PRUNED model	1.3	9.6	207	79	1.4

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基于表面的 匹配技术改进

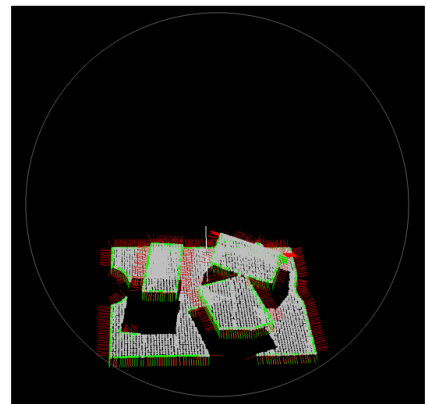


基于边缘的表面匹配技术改进

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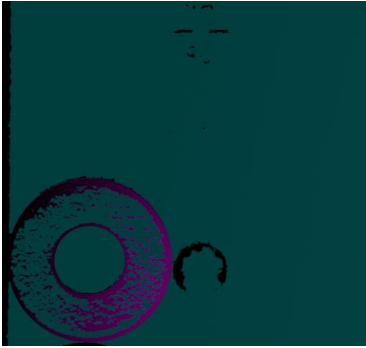
对于复杂的3D场景，匹配速度更快



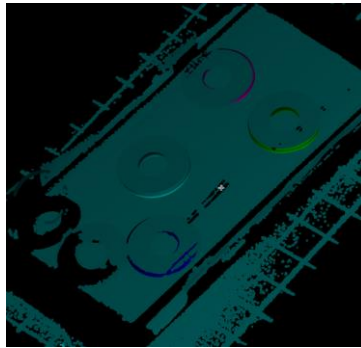
不再需要设置视点

基于边缘的表面匹配技术更快

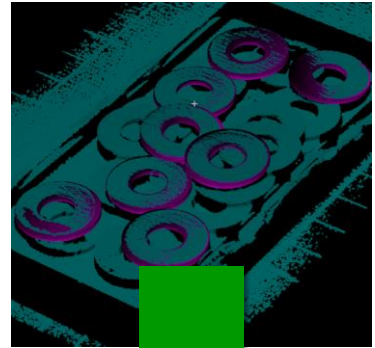
DAHENG IMAGING | 大恒图像



加速：0%



加速：~50%



加速：~195%

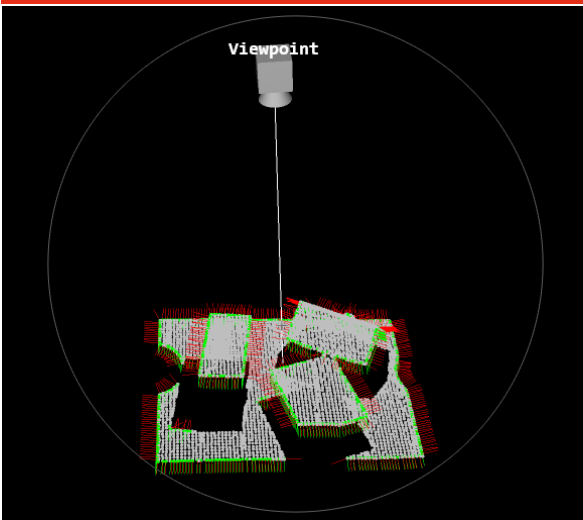
物体/边缘数量

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不再需要设置视点

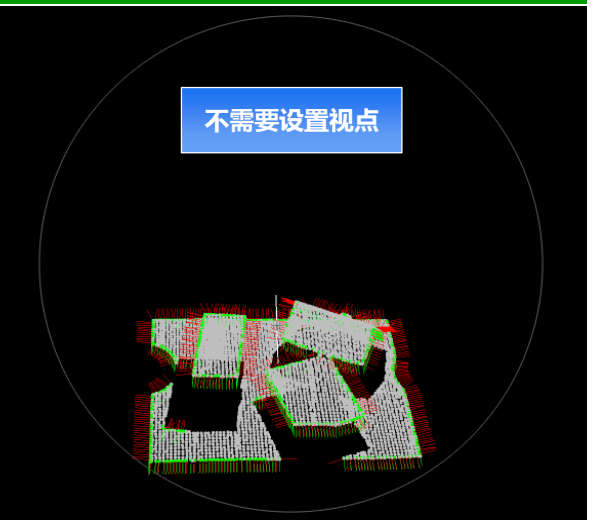
DAHENG IMAGING | 大恒图像

HALCON 20.05



HALCON 20.11

不需要设置视点

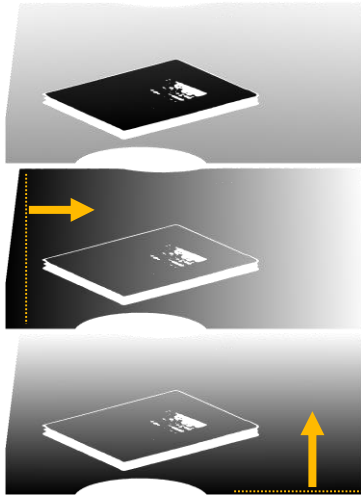


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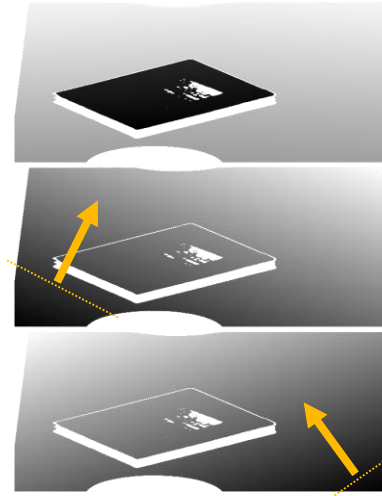
不需要XYZ的映射约定

DAHENG IMAGING | 大恒图像

HALCON 20.05



HALCON 20.11

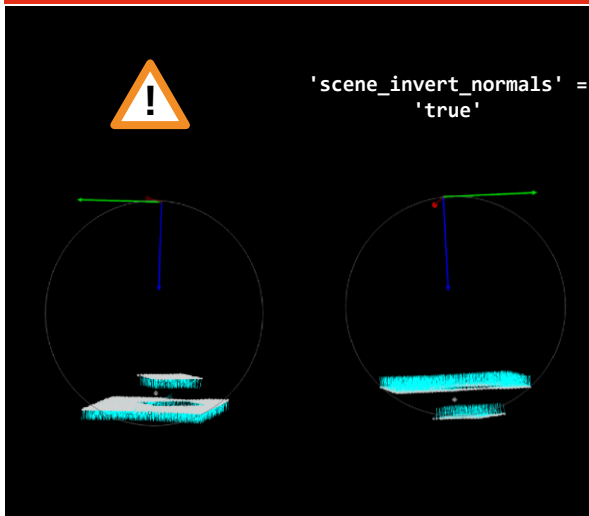


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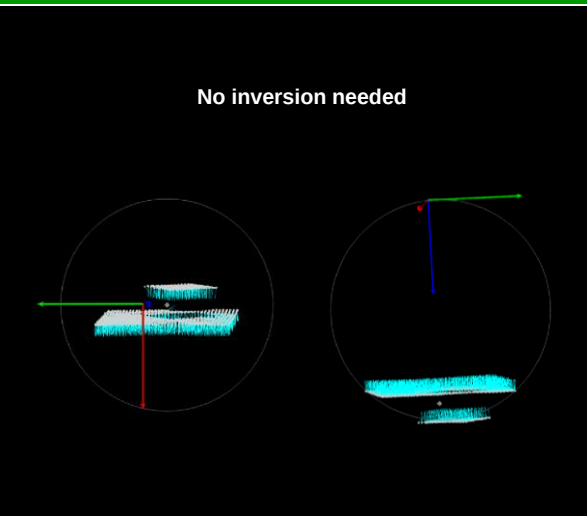
基于边缘的表面匹配的自动法线对齐

DAHENG IMAGING | 大恒图像

HALCON 20.05



HALCON 20.11

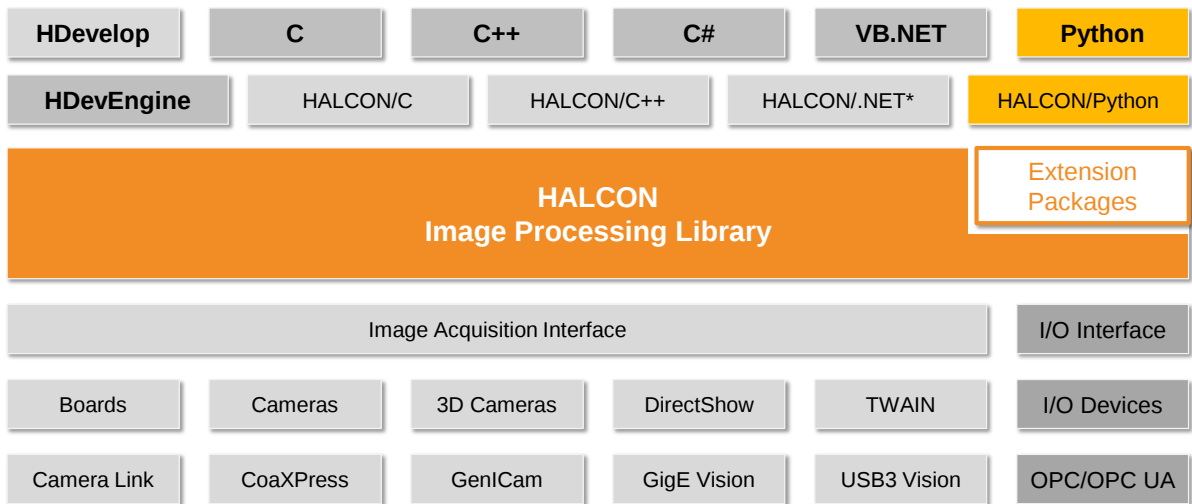


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引入HALCON/Python接口

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*HALCON/.NET Framework and HALCON/.NET Core available

HALCON安装提供了示例和文档

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The screenshot displays two windows from the HALCON installation documentation. On the left, a code editor shows the 'console_app.py' example, which demonstrates how to use the HALCON Python interface. The code includes comments in Chinese and Python code that reads an image, applies a threshold, and counts the regions. On the right, a web browser shows the 'threshold (Operator)' reference page. The page includes the operator's name, signature, description, attention points, and execution information. The 'Python' tab is selected in the browser's top navigation bar.

```

1  """
2  *****
3  exec_procedures.py - HDevEngine example for HALCON/Python
4  *****
5  matching.py - Matching example for HALCON/Python
6  *****
7  console_app.py - Minimal console example for HALCON/Python
8  *****
9
10 Project: HALCON/Python
11 Description:
12 Minimal console example that shows how to call HALCON's operators in Python.
13 *****
14 (c) 1996-2020 by MVTec Software GmbH
15
16 Software by: MVTec Software GmbH, www.mvtec.com
17 *****
18
19 import halcon as ha
20
21 if __name__ == '__main__':
22     img = ha.read_image('pcb')
23
24     region = ha.threshold(img, 0, 122)
25     num_regions = ha.count_obj(ha.connection(region))
26
27     print(f'Number of Regions: {num_regions}')
  
```

threshold (Operator)

Name
threshold — Segment an image using global threshold.

Signature
def threshold(image: HObject, min_gray: MaybeSequence[Union[int, float, str]], max_gray: MaybeSequence[Union[int, float, str]]) -> HObject

Description
threshold selects the pixels from the input image whose gray values g fulfill the following condition:
 $\text{MinGray} \leq g \leq \text{MaxGray}$

Attention
For input images of an integer type, floating point values in `min_gray` and `max_gray` are truncated.

Execution Information

- Multithreading type: reentrant (runs in parallel with non-exclusive operators).
- Multithreading scope: global (may be called from any thread).
- Automatically parallelized on tuple level.
- Automatically parallelized on internal data level.

使用HALCON / Python非常容易

DAHENG IMAGING | 大恒图像

The screenshot displays two windows from the HALCON installation documentation. On the left, a code editor shows the 'console_app.py' example, which demonstrates how to use the HALCON Python interface. The code includes comments in Chinese and Python code that reads an image, applies a threshold, and counts the regions. On the right, a web browser shows the 'HALCON a product of MVTec' logo and the 'Programmer's Guide' table of contents. The '15 HALCON/Python Interface' section is highlighted, showing a list of topics including module import, using HALCON operators, and handling errors.

```

1  """
2  *****
3  console_app.py - Minimal console example for HALCON/Python
4  *****
5
6 Project: HALCON/Python
7 Description:
8 Minimal console example that shows how to call HALCON's operators in Python.
9 *****
10 (c) 1996-2020 by MVTec Software GmbH
11
12 Software by: MVTec Software GmbH, www.mvtec.com
13 *****
14
15 import halcon as ha
16
17 if __name__ == '__main__':
18     img = ha.read_image('pcb')
19
20     region = ha.threshold(img, 0, 122)
21     num_regions = ha.count_obj(ha.connection(region))
22
23     print(f'Number of Regions: {num_regions}')
  
```

HALCON
a product of MVTec

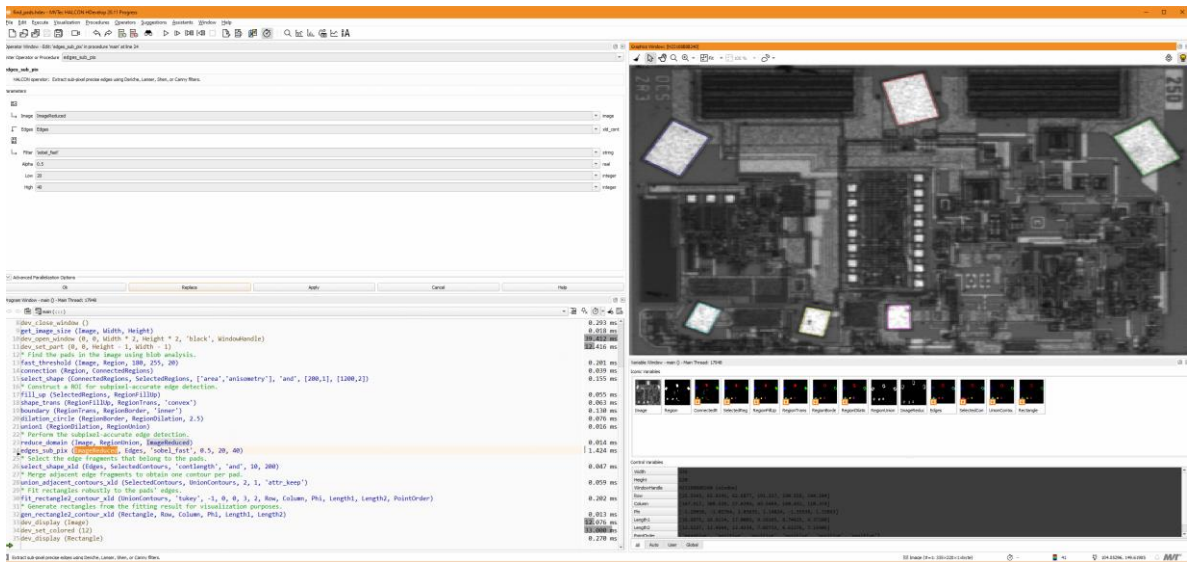
Programmer's Guide

- 13 Introducing HALCON/Python
 - 13.1 A First Example
- 14 Creating Applications With HALCON/Python
 - 14.1 Python Development Environments
 - 14.2 Adding HALCON/Python to an Application
 - 14.3 Deploying an Application
 - 14.4 Using a Newer HALCON/Python Release
- 15 HALCON/Python Interface
 - 15.1 Module Import
 - 15.2 Using HALCON Operators From HALCON/Python
 - 15.3 Operators Are Standalone Functions
 - 15.4 Inputs Are Parameters, Outputs Are Return Values
 - 15.5 Tuple is Represented with Native Python Types
 - 15.6 HHandle
 - 15.7 HObject
 - 15.8 Output Values
 - 15.9 Error Handling
 - 15.10 Garbage Collection
 - 15.11 Named Parameters
 - 15.12 Operator And Parameter Capitalization



HDevelop 进行了改头换面

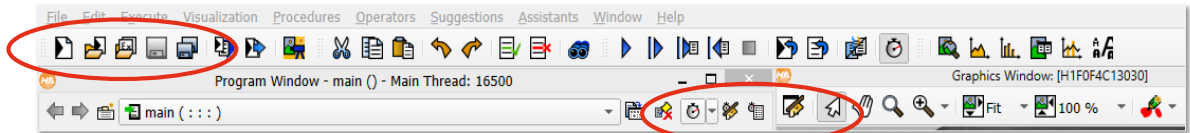
DAHENG IMAGING | 大恒图像



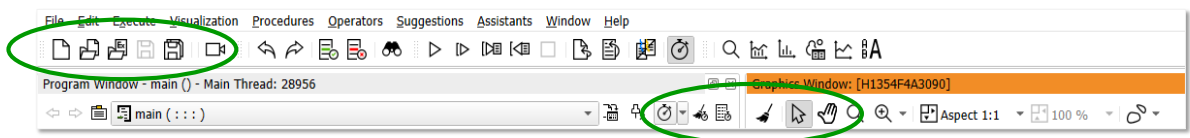
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HDevelop的工具栏图标重新设计

HDevelop 20.05

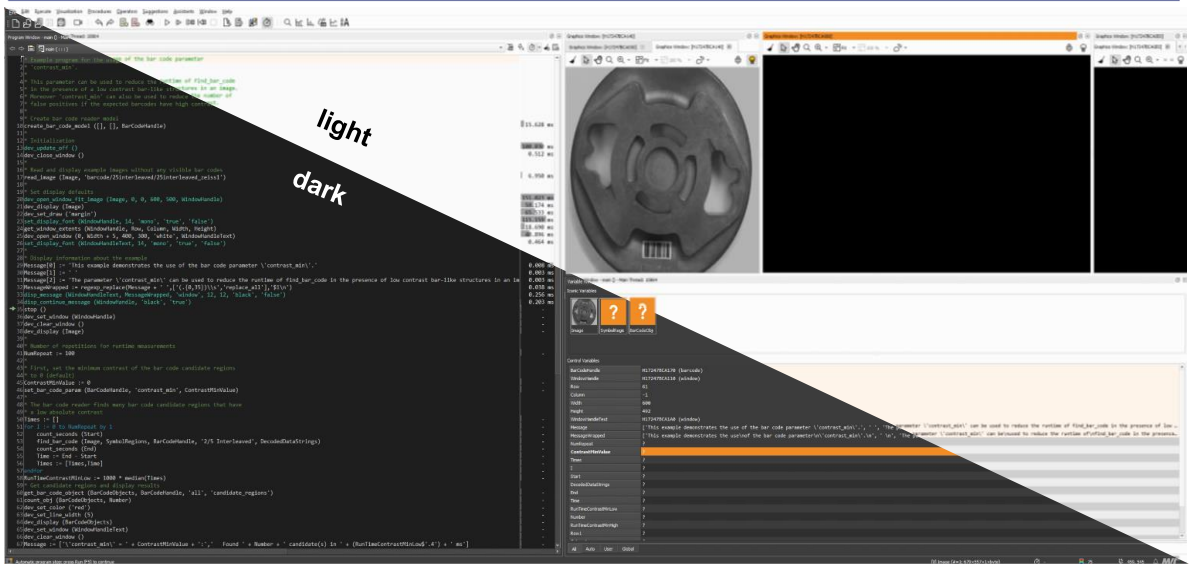


HDevelop 20.11



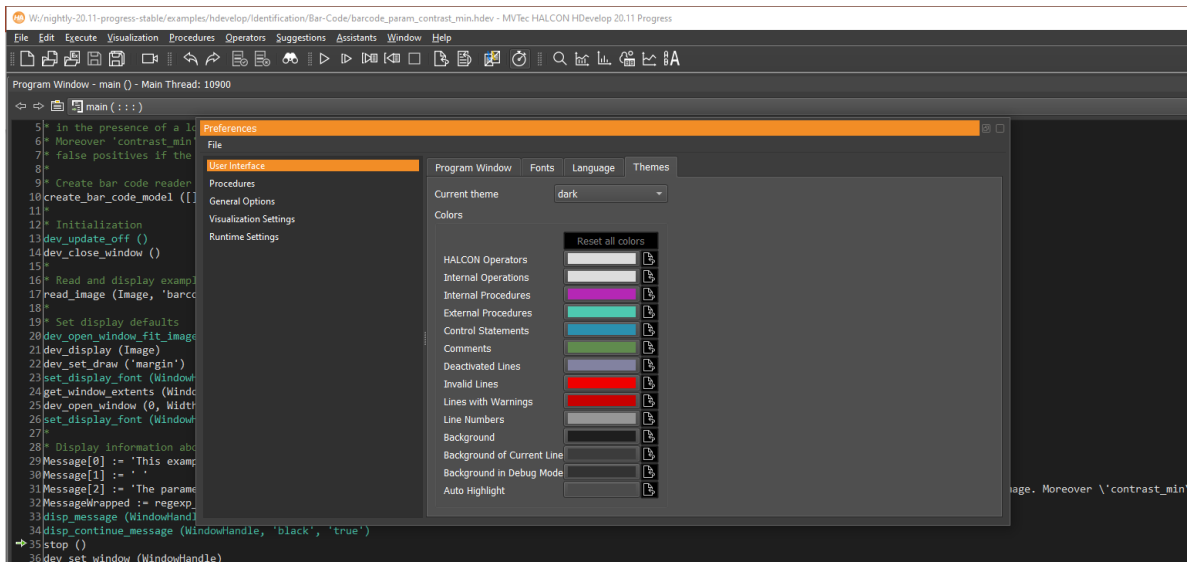
www.daheng-imaging.com

在两种配色方案之间切换



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HDevelop 20.11中的主题 - 黑暗主题



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HDevelop为图形窗口提供了新的调整大小模式

- 全拉伸**
图像根据窗口大小拉伸
- 保持宽高比**
更改缩放级别并保持
更改前的宽高比
- 无拉伸**
调整窗口大小后，图像尺寸不会改变

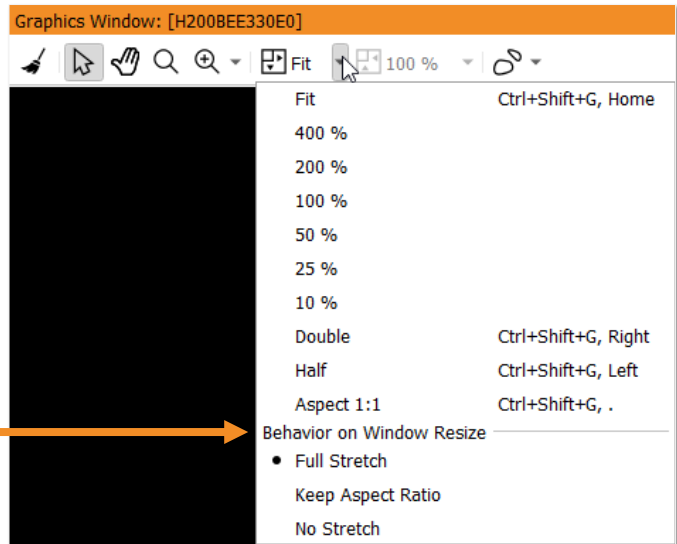


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如何更改给定窗口的调整大小模式

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在图形窗口的工具栏中更改调整大小行为

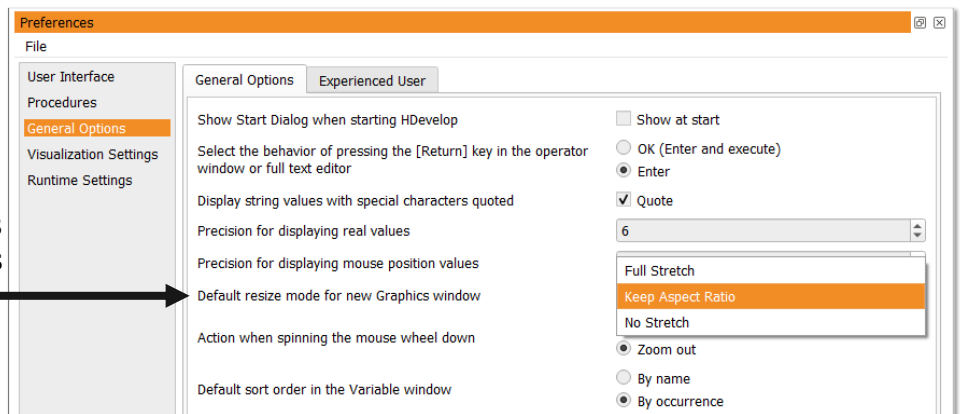


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如何更改默认的调整大小模式

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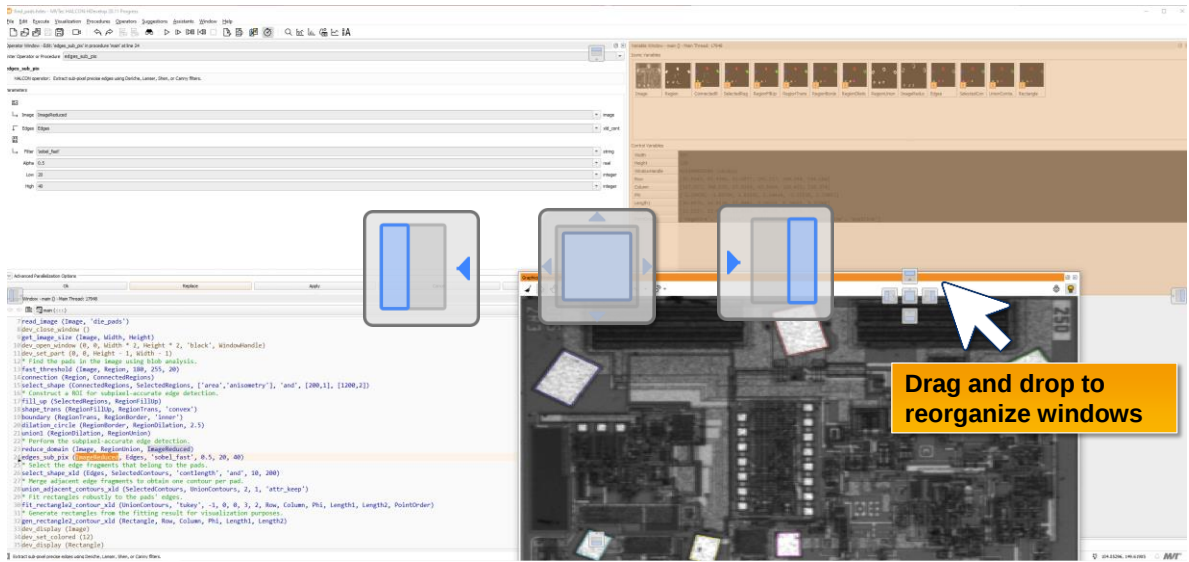
默认模式改变
Edit → Preferences
→ General Options



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快速调整HDevelop的窗口布局以适应

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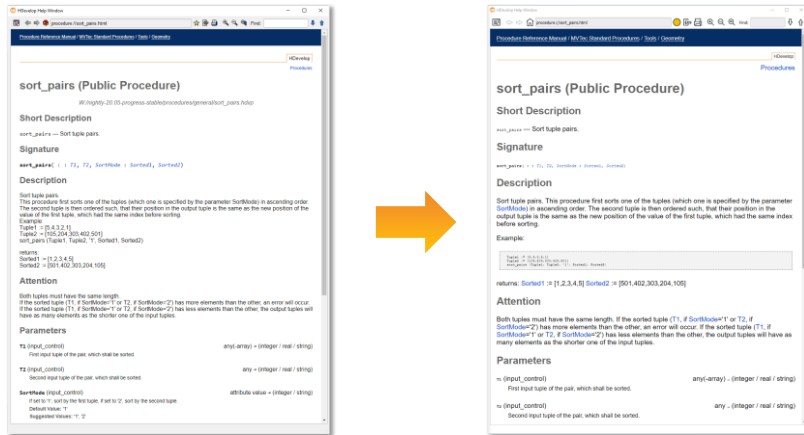


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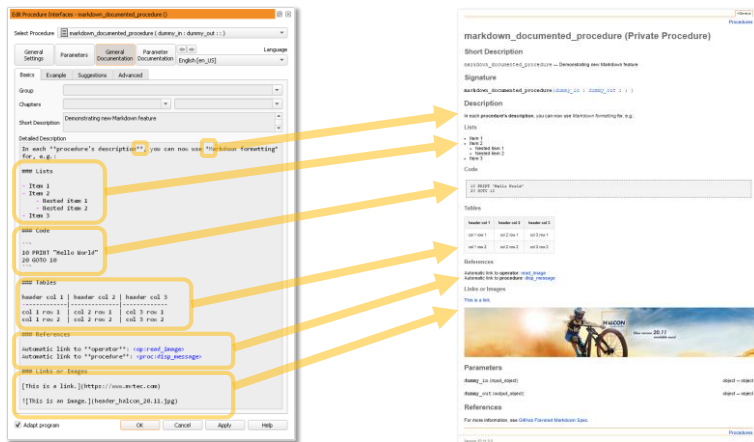
支持Markdown
的编写程序文档



新程序文档的视觉效果



使用Markdown格式化程序文档



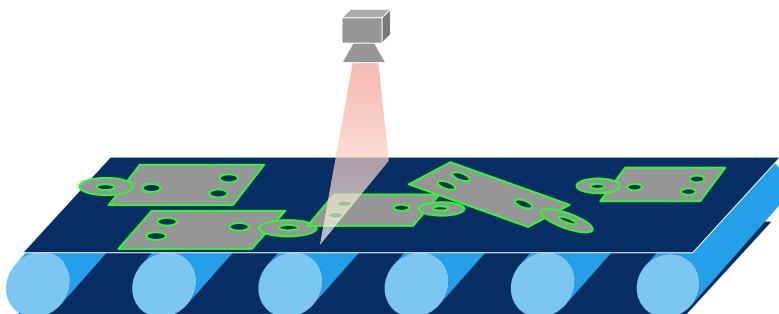


减少find_*_shape_model的临时内存

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内存减少的嵌入式系统

AngleStep和ScaleStep较小的大型模型



减少find_*_shape_model的临时内存

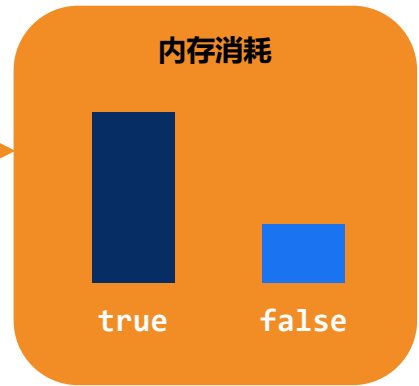
临时内存可以通过以下算子减少

set_shape_model_param (::

◀ ModelID,

◀ 'model_cache',

◀ false:)



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减少find_*_shape_model的临时内存



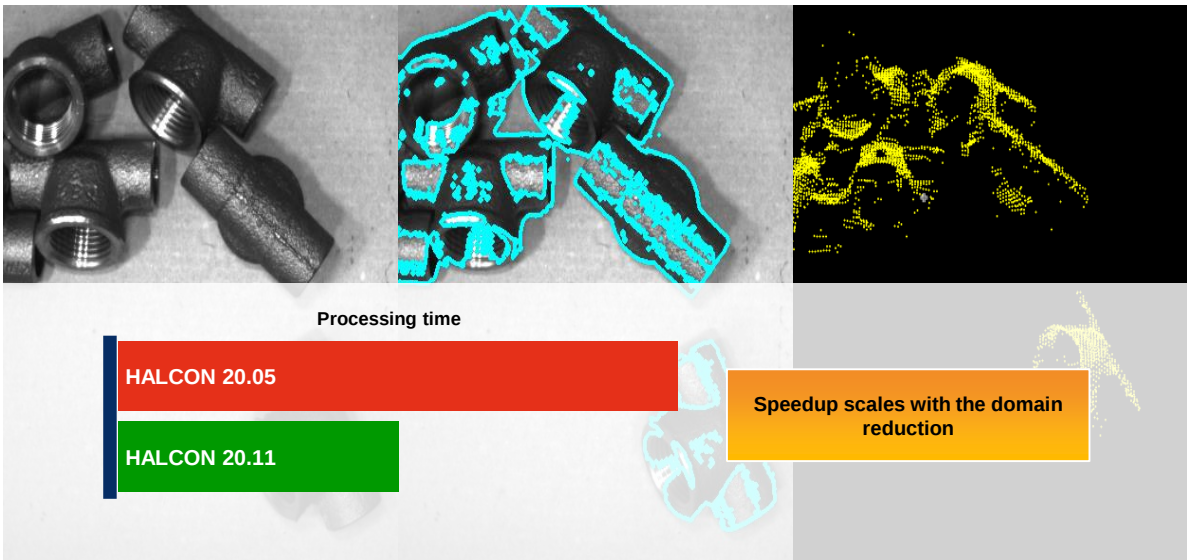
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3D重构技术 改进



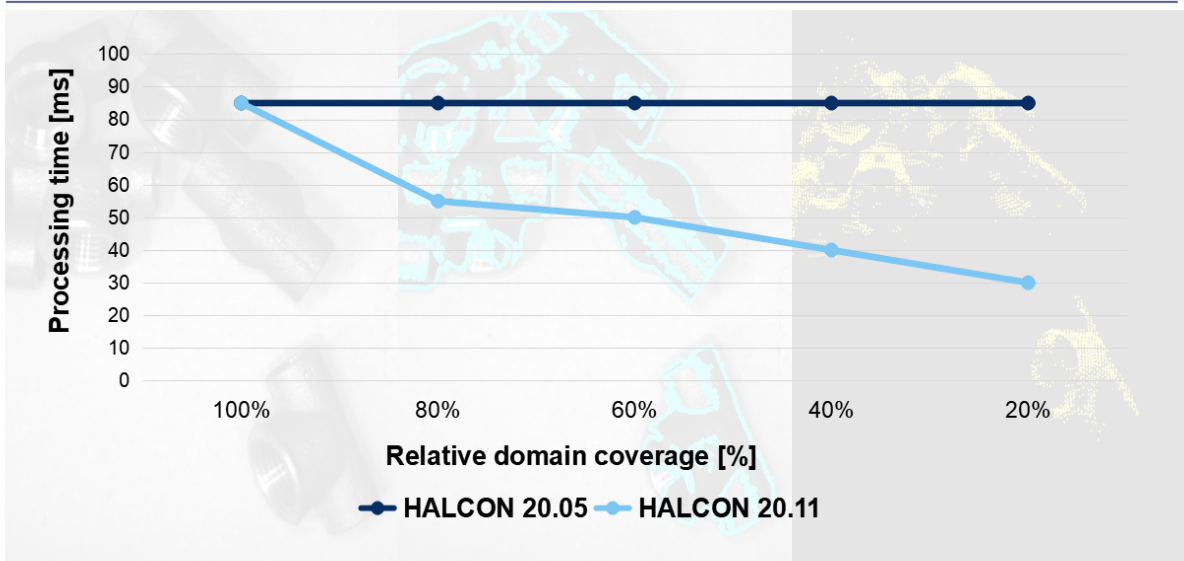
reconstructor_surface_stereo支持图像域

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reconstructor_surface_stereo支持图像域

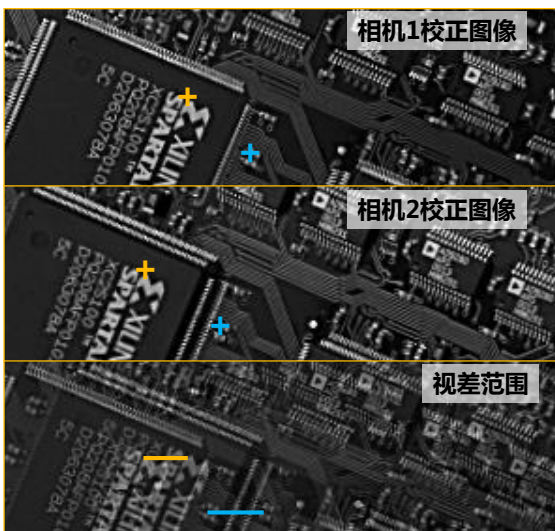
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使用set_stereo_model_param设置视差范围

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对于每个图像对:

```
set_stereo_model_param(
  ▶ StereoModelID,
  ▶ 'min_disparity',
  ▶ [-30, -5])
```

```
set_stereo_model_param(
  ▶ StereoModelID,
  ▶ 'max_disparity',
  ▶ [-20, +5])
```

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set_stereo_model_param参数'rectif_interpolation'默认值改变

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```
set_stereo_model_param(  
  ▶ StereoModelID,  
  ▶ 'rectif_interpolation',  
  ▶ 'none')
```

Avoid aliasing
artifacts

```
set_stereo_model_param(  
  ▶ StereoModelID,  
  ▶ 'rectif_interpolation',  
  ▶ 'bilinear')
```

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更多新特性



HALCON 20.11支持更多ONNX操作符导入

DAHENG IMAGING | 大恒图像

✓ Add

20.11 ArgMax

✓ AveragePool

✓ BatchNormalization

20.11 Clip

✓ Concat

✓ Conv

✓ Dropout

✓ Gemm

✓ GlobalAveragePool

✓ GlobalMaxPool

✓ LogSoftmax

✓ LRN

✓ MaxPool

20.11 ReduceMax

✓ Relu

20.11 Resize

✓ Reshape

20.11 Sigmoid

✓ Softmax

✓ Sum



ONNX

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HALCON 20.11 提供 MobileNet V2

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COMPACT



optimized for
highest speed



ENHANCED



optimized for best
classification rates

20.11



MOBILENET V2



ALEXNET



optimized for
simple tasks



RESNET-50



optimized for very
complex tasks



optimized for
low-power applications

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HALCON 20.11 提供 MobileNet V2

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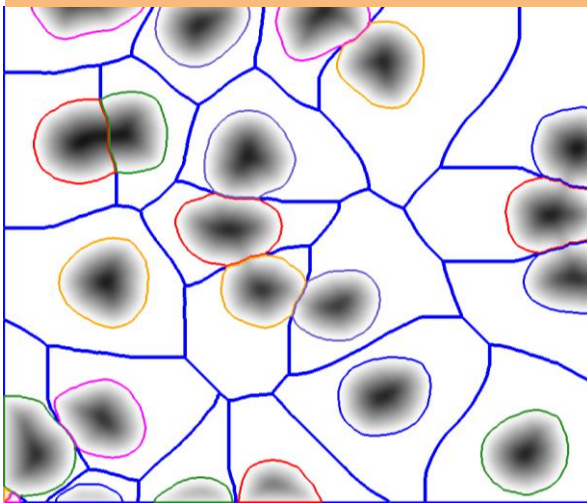
	compact	enhanced	resnet50	alexnet	mobilenet_v2
CPU inference [Intel(R) Xeon(R) CPU E5-2637 v4 @ 3.50GHz]	3.9 ms	17.7 ms	38.8 ms	18.8 ms	11.8 ms
GPU inference [NVIDIA RTX 2080 Ti]	0.7 ms	2.6 ms	3.5 ms	1.2 ms	1.6 ms

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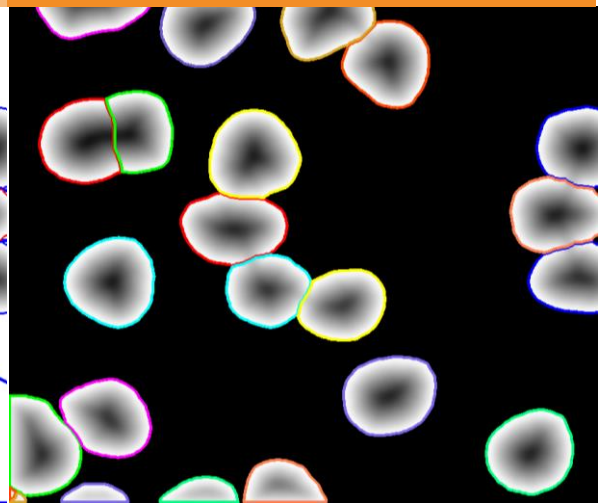
watersheds_* 现在支持图像域

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On full domain with region intersection



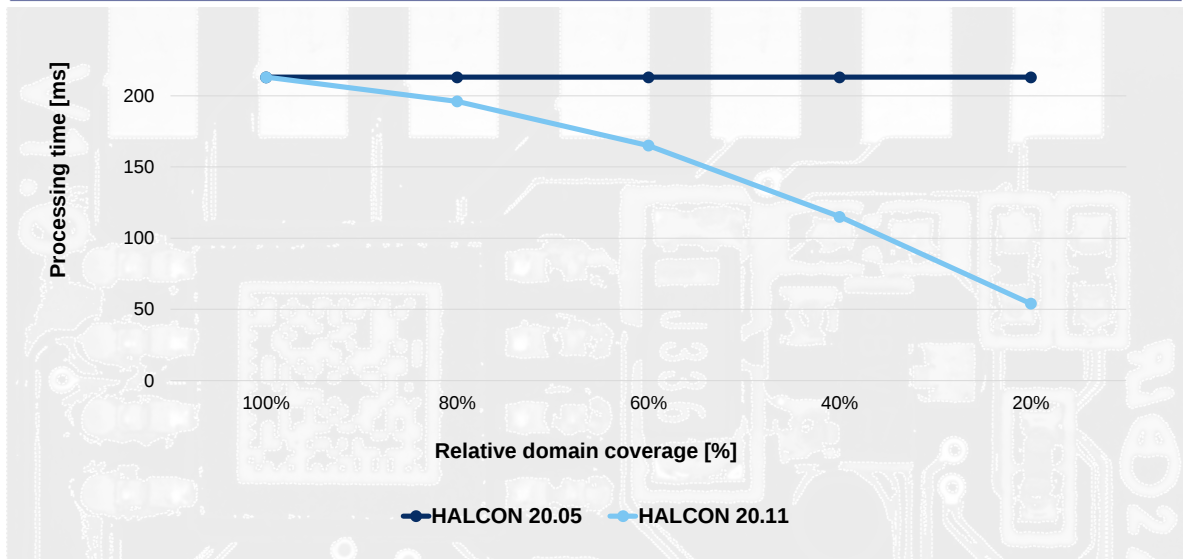
On reduced domain



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通过reduce_domain, watersheds_*变得更快

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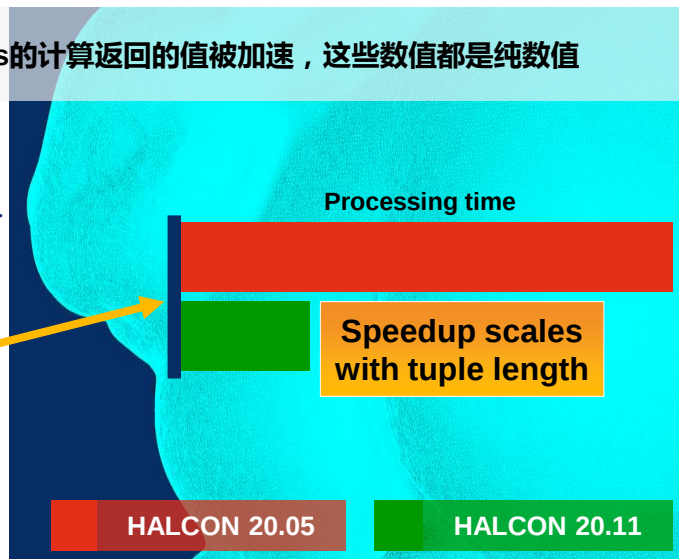
get_object_model_3d_params 返回纯数组

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get_object_model_3d_params 的计算返回的值被加速，这些数值都是纯数值

```
* Get values for normals,
* coordinates, mappings, distances, ...
get_object_model_3d_params \
( ObjectModel3D, 'point_coord_x', X )
get_object_model_3d_params \
( ObjectModel3D, 'point_coord_y', Y )

* Compute these values
R := sqrt(X*X+Y*Y)
```



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HALCON 不再支持Win32

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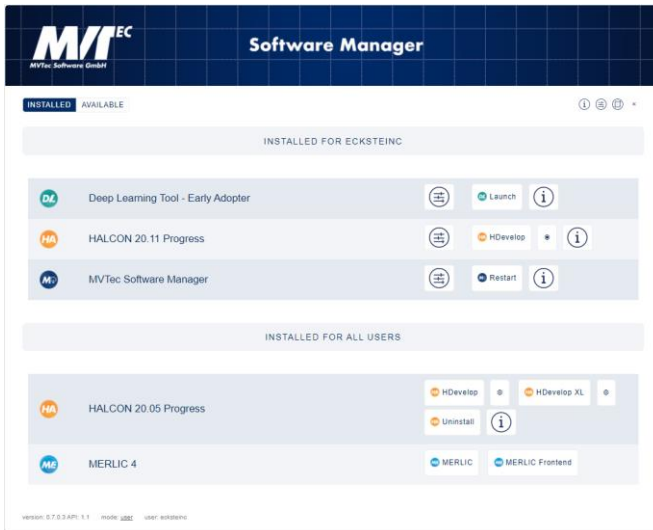


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**MVTec
软件管理器
早鸟版**



MVTec软件管理器 (SOM) 可以帮助管理MVTec 产品



除了常规的HALCON安装程序包外，
还提供其他产品

安装 HALCON 20.11

仅选择所需安装包

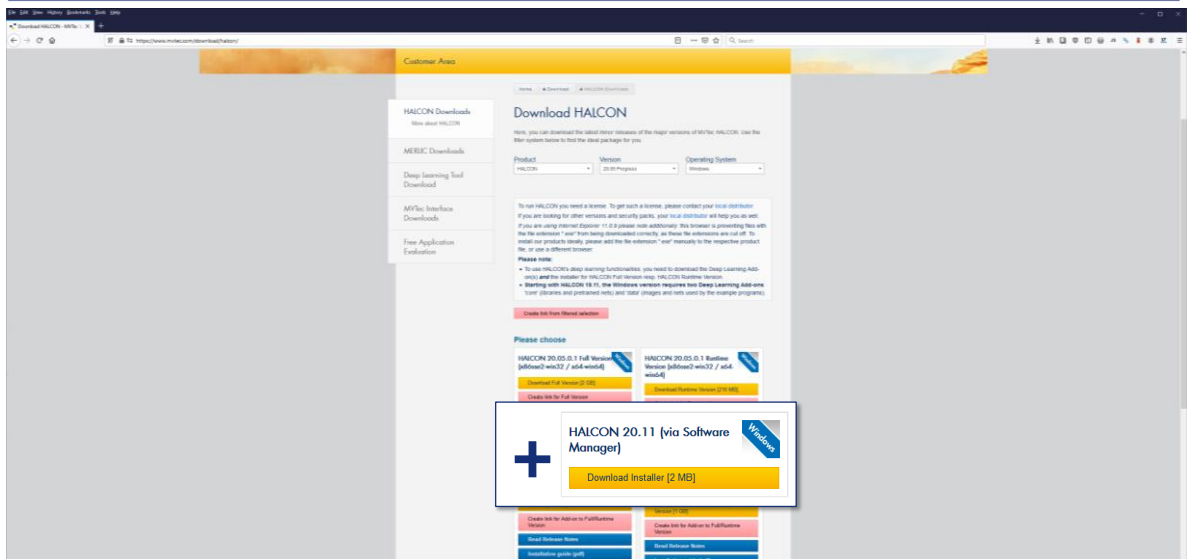
安装管理

注册默认HALCON版本

启动 MVTec 产品

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MVTec软件管理器 (SOM) 可以帮助管理MVTec 产品



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中国大恒(集团)有限公司北京图像视觉技术分公司
China Daheng Group, Inc. Beijing Image Vision Technology Branch

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