inspect_data

April 22, 2022

[109]:

```
import os
import sys
import itertools
import math
import logging
import json
import re
import random
from collections import OrderedDict
import numpy as np
import matplotlib
import matplotlib.pyplot as plt
import matplotlib.patches as patches
import matplotlib.lines as lines
from matplotlib.patches import Polygon

# Der Pfad der Mask R_CNN Projektdatei

ROOT_DIR = os.path.abspath("C:/Users/majd4/Desktop/Bachelorarbeit/
 ↪Bachelor-Arbeit-Daten/MaskRCNNProjekt/MaskRCNN_2/Mask_RCNN")

# Mask R_CNN importieren
sys.path.append(ROOT_DIR)
from mrcnn import utils
from mrcnn import visualize
from mrcnn.visualize import display_images
import mrcnn.model as modellib
from mrcnn.model import log

from samples.Tipvortexcavitation import Tipvortexcavitation

%matplotlib inline
```

[110]:

```
config = Tipvortexcavitation.TipvortexcavitationConfig()
Tipvortexcavitationdir = os.path.join(ROOT_DIR, "datasets/Tipvortexcavitation")
```

[111]:

```
# Datensatz laden.
dataset = Tipvortexcavitation.TipvortexcavitationDataset()
dataset.load_Tipvortexcavitation(Tipvortexcavitationdir, "train")


dataset.prepare()

print("Image Count: {}".format(len(dataset.image_ids)))
print("Class Count: {}".format(dataset.num_classes))
for i, info in enumerate(dataset.class_info):
    print("{:3}. {:50}".format(i, info['name']))
```

```
Image Count: 22
Class Count: 2
  0. BG
  1. Tipvortexcavitation
```

[112]:

```
# 4 Bilder zufällig auswählen, laden und visualisieren
# Masken erzeugen
image_ids = np.random.choice(dataset.image_ids, 5)
for image_id in image_ids:
    image = dataset.load_image(image_id)
    mask, class_ids = dataset.load_mask(image_id)
    visualize.display_top_masks(image, mask, class_ids, dataset.class_names)
```

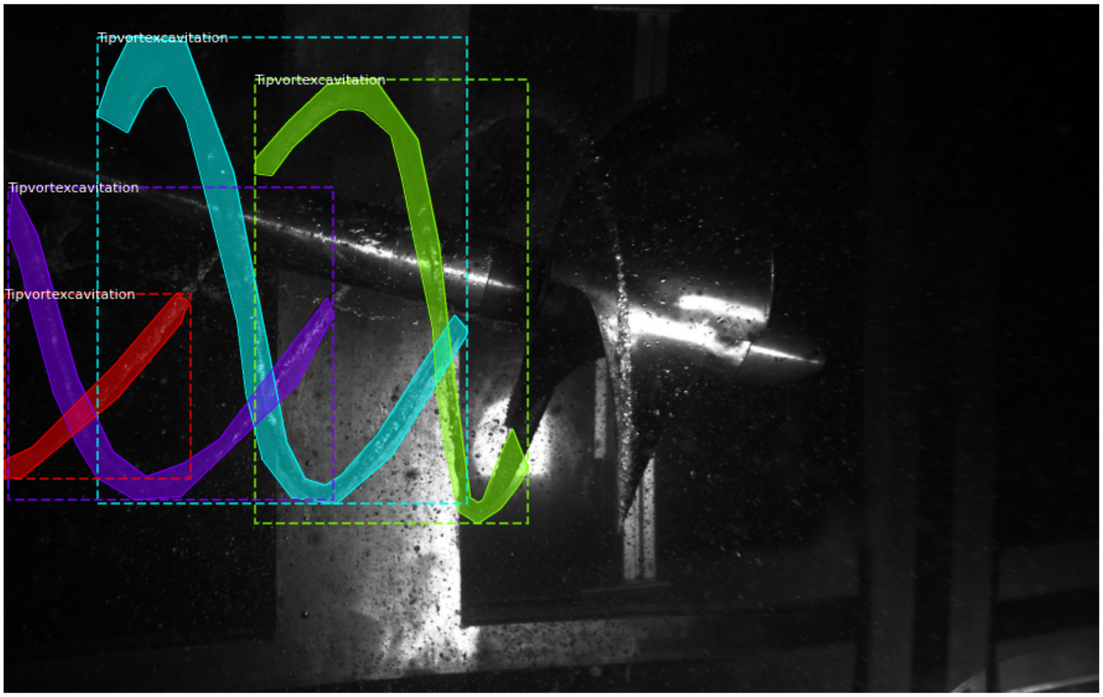
H x W=1216x1936
Tipvortexcavitation
-
-
-

H x W=960x1280
Tipvortexcavitation
-
-
-

[113]:

```python
# zufälliges Bild und zufällige Maske auswählen
image_id = random.choice(dataset.image_ids)
image = dataset.load_image(image_id)
mask, class_ids = dataset.load_mask(image_id)

#  Bounding box berechnen
bbox = utils.extract_bboxes(mask)

# Bild anzeigen und Die Position und die Shape von Bounding box ausgeben.
# Bouding box begrenzt das Objekt von dem Gesamtbild in einem Rahmen

print("image_id ", image_id, dataset.image_reference(image_id))
log("image", image)
log("mask", mask)
log("class_ids", class_ids)
log("bbox", bbox)

visualize.display_instances(image, bbox, mask, class_ids, dataset.class_names)
```

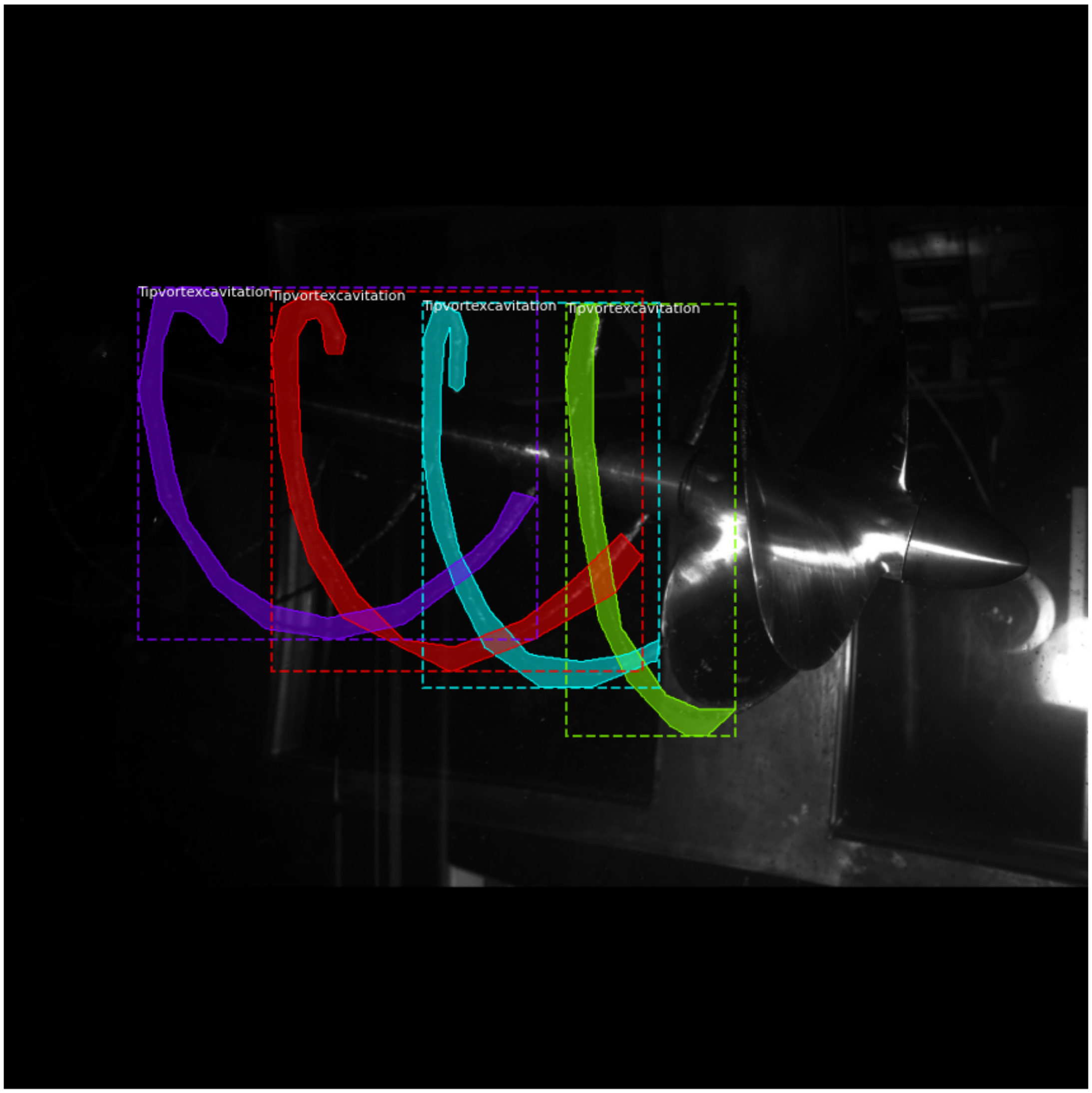
```
image_id  11 C:\Users\majd4\Desktop\Bachelorarbeit\Bachelor-Arbeit-Daten\MaskRCN
NProjekt\MaskRCNN_2\Mask_RCNN\datasets/Tipvortexcavitation\train\Neue Videos_000
0000005_2021_11_17_15_38_57_640_2021_11_17_14_38_57_627_224966731932_289408.png
image                    shape: (1216, 1936, 3)       min:    0.00000  max:
255.00000  uint8
mask                     shape: (1216, 1936, 4)       min:    0.00000  max:
1.00000  bool
class_ids                shape: (4,)                  min:    1.00000  max:
1.00000  int32
bbox                     shape: (4, 4)                min:    2.00000  max:
927.00000  int32
```



[114]:

```
# zufälliges Bild und zufällige Maske hochladen
image_id = np.random.choice(dataset.image_ids, 1)[0]
image = dataset.load_image(image_id)
mask, class_ids = dataset.load_mask(image_id)
original_shape = image.shape
# Größe ändern.
image, window, scale, padding, _ = utils.resize_image(
    image,
    min_dim=  config.IMAGE_MIN_DIM,
    max_dim=config.IMAGE_MAX_DIM,
    mode=config.IMAGE_RESIZE_MODE)
mask = utils.resize_mask(mask, scale, padding)

bbox = utils.extract_bboxes(mask)

print("image_id: ", image_id, dataset.image_reference(image_id))
print("Original shape: ", original_shape)
log("image", image)
log("mask", mask)
log("class_ids", class_ids)
log("bbox", bbox)

visualize.display_instances(image, bbox, mask, class_ids, dataset.class_names)
```

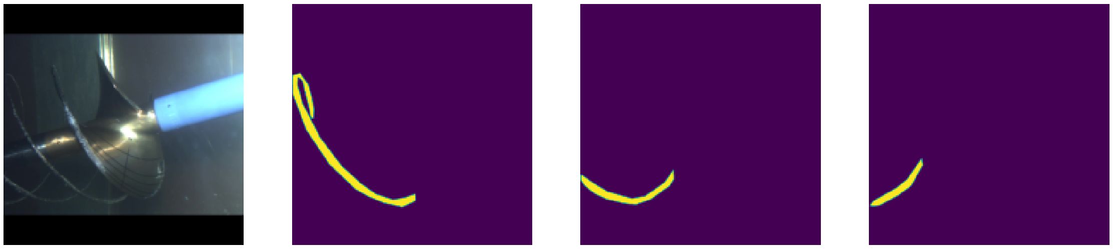
```
image_id:  8 C:\Users\majd4\Desktop\Bachelorarbeit\Bachelor-Arbeit-Daten\MaskRCN
NProjekt\MaskRCNN_2\Mask_RCNN\datasets/Tipvortexcavitation\train\Neue Videos_000
0000004_2021_11_17_15_29_17_182_2021_11_17_14_29_17_168_219170316395_225398.png
Original shape:  (1216, 1936, 3)
image                    shape: (1024, 1024, 3)       min:    0.00000  max:
255.00000  uint8
mask                     shape: (1024, 1024, 4)       min:    0.00000  max:
1.00000  bool
class_ids                shape: (4,)                  min:    1.00000  max:
1.00000  int32
bbox                     shape: (4, 4)                min:  127.00000  max:
691.00000  int32
```



[115]:

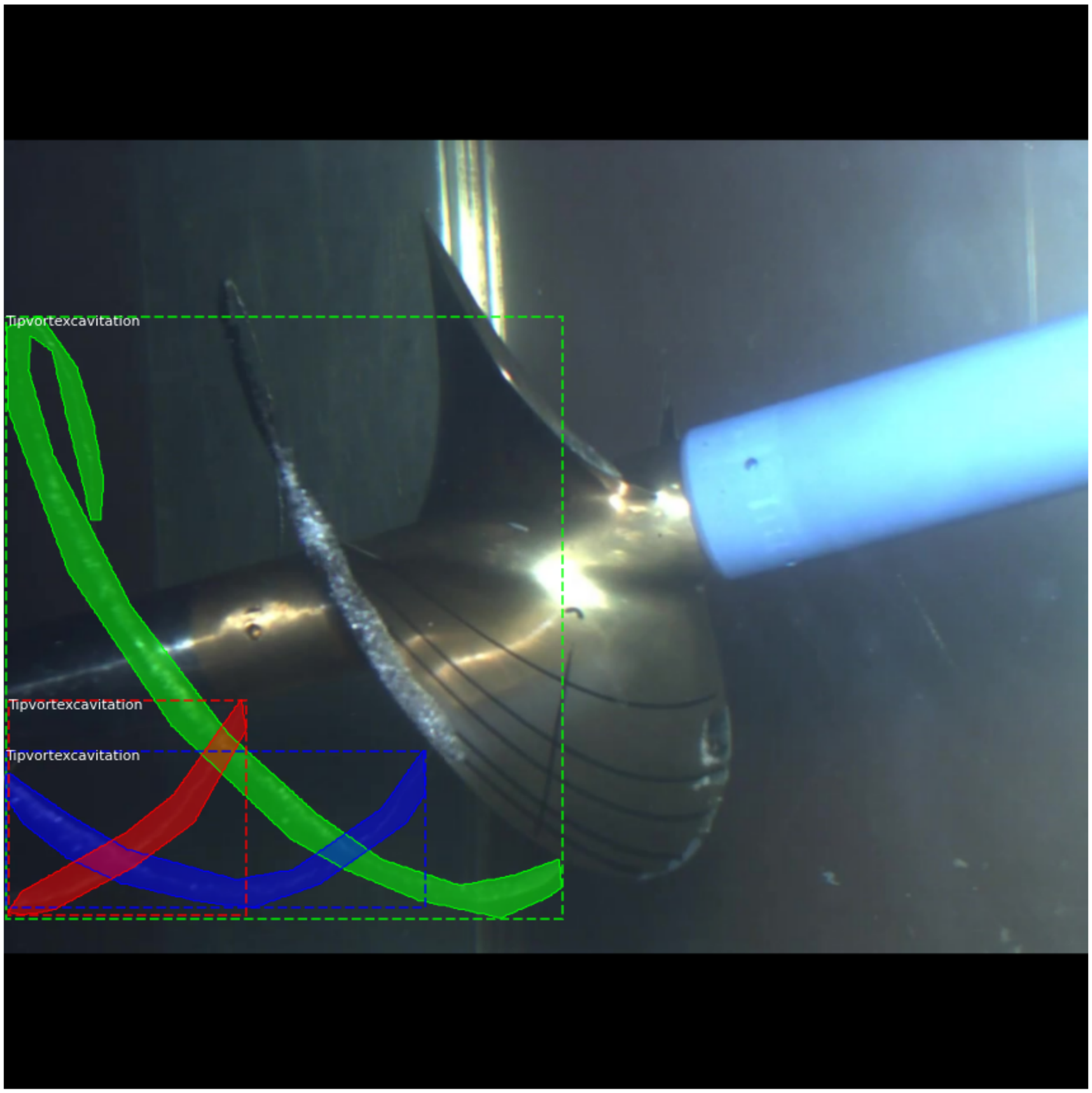
```
image_id = np.random.choice(dataset.image_ids, 1)[0]
image, image_meta, class_ids, bbox, mask = modellib.load_image_gt(
    dataset, config, image_id, use_mini_mask=False)

log("image", image)
log("image_meta", image_meta)
log("class_ids", class_ids)
log("bbox", bbox)
log("mask", mask)

display_images([image]+[mask[:,:,i] for i in range(min(mask.shape[-1], 7))])
```

```
image                    shape: (1024, 1024, 3)       min:    0.00000  max:
255.00000  uint8
image_meta               shape: (14,)                 min:    0.00000  max:
1280.00000  float64
class_ids                shape: (3,)                  min:    1.00000  max:
1.00000  int32
bbox                     shape: (3, 4)                min:    2.00000  max:
862.00000  int32
mask                     shape: (1024, 1024, 3)       min:    0.00000  max:
1.00000  bool
```



[116]:

```
visualize.display_instances(image, bbox, mask, class_ids, dataset.class_names)
```



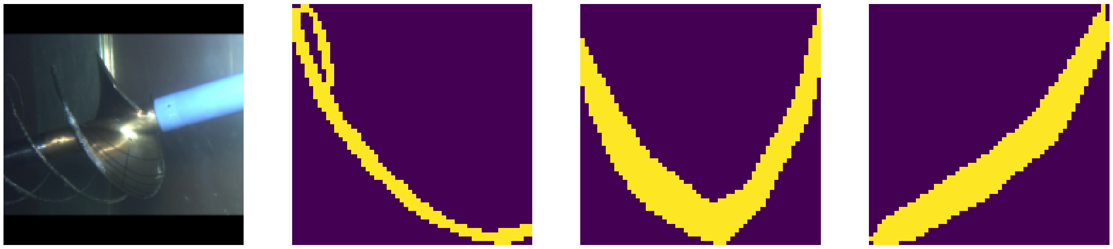
```
[117]: image, image_meta, class_ids, bbox, mask = modellib.load_image_gt(
           dataset, config, image_id, augment=True, use_mini_mask=True)
       log("mask", mask)
       display_images([image]+[mask[:,:,i] for i in range(min(mask.shape[-1], 7))])
```

```
WARNING:root:'augment' is deprecated. Use 'augmentation' instead.
```

```
mask                     shape: (56, 56, 3)          min:    0.00000  max:
1.00000  bool
```

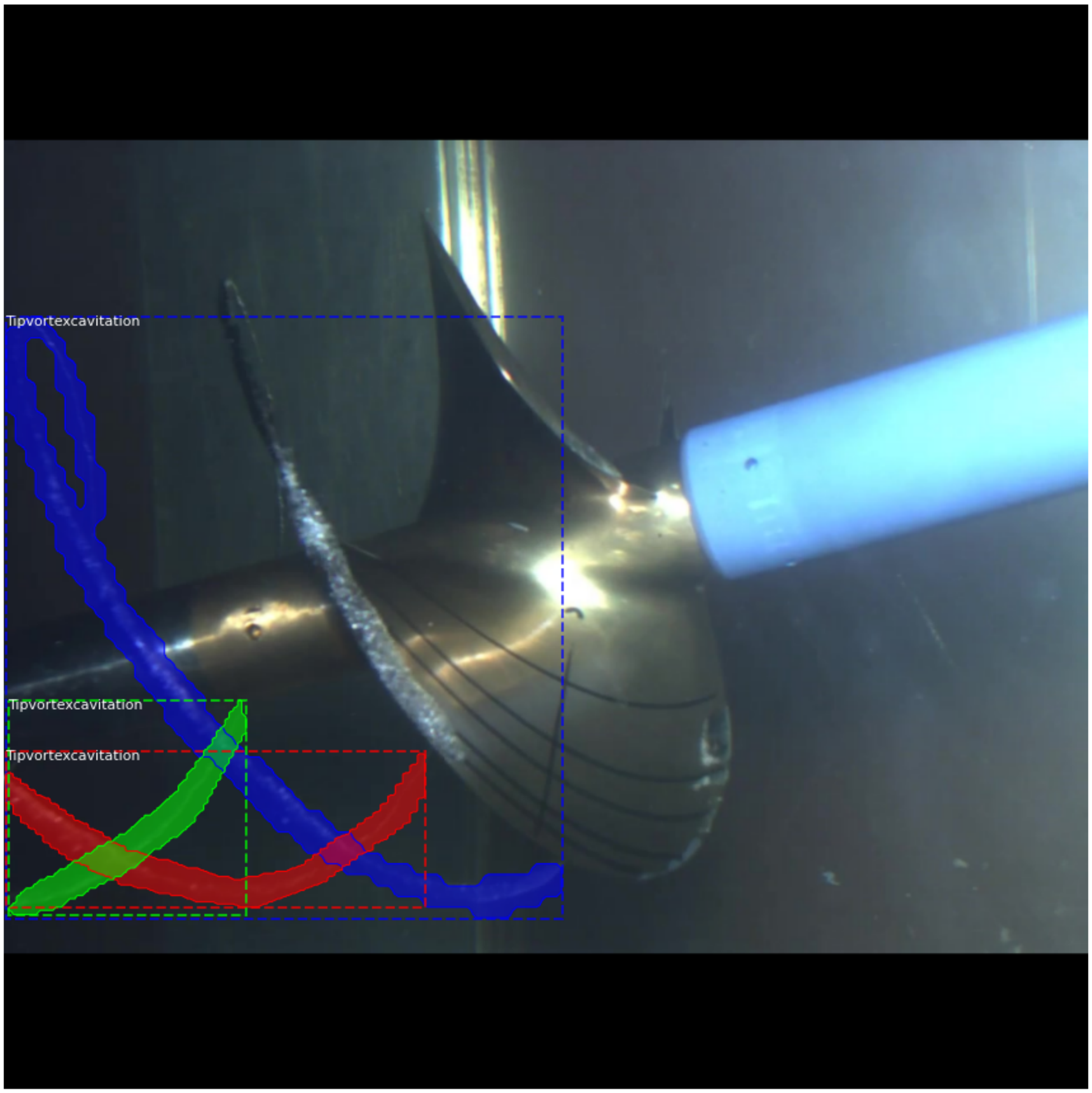
```
C:\Users\majd4\anaconda3\envs\Matterprot_MaskRCNN\lib\site-
packages\skimage\transform\_warps.py:830: FutureWarning: Input image dtype is
bool. Interpolation is not defined with bool data type. Please set order to 0 or
explicitely cast input image to another data type. Starting from version 0.19 a
```

```
ValueError will be raised instead of this warning.
  order = _validate_interpolation_order(image.dtype, order)
```



[118]:

```
mask = utils.expand_mask(bbox, mask, image.shape)
visualize.display_instances(image, bbox, mask, class_ids, dataset.class_names)
```



[119]:

```
# Generate Anchors
backbone_shapes = modellib.compute_backbone_shapes(config, config.IMAGE_SHAPE)
anchors = utils.generate_pyramid_anchors(config.RPN_ANCHOR_SCALES,
                                          config.RPN_ANCHOR_RATIOS,
                                          backbone_shapes,
                                          config.BACKBONE_STRIDES,
                                          config.RPN_ANCHOR_STRIDE)

# Print summary of anchors
num_levels = len(backbone_shapes)
anchors_per_cell = len(config.RPN_ANCHOR_RATIOS)
print("Count: ", anchors.shape[0])
print("Scales: ", config.RPN_ANCHOR_SCALES)
print("ratios: ", config.RPN_ANCHOR_RATIOS)
print("Anchors per Cell: ", anchors_per_cell)
print("Levels: ", num_levels)
anchors_per_level = []
for l in range(num_levels):
    num_cells = backbone_shapes[l][0] * backbone_shapes[l][1]
    anchors_per_level.append(anchors_per_cell * num_cells // config.
 ↪RPN_ANCHOR_STRIDE**2)
    print("Anchors in Level {}: {}".format(l, anchors_per_level[l]))
```

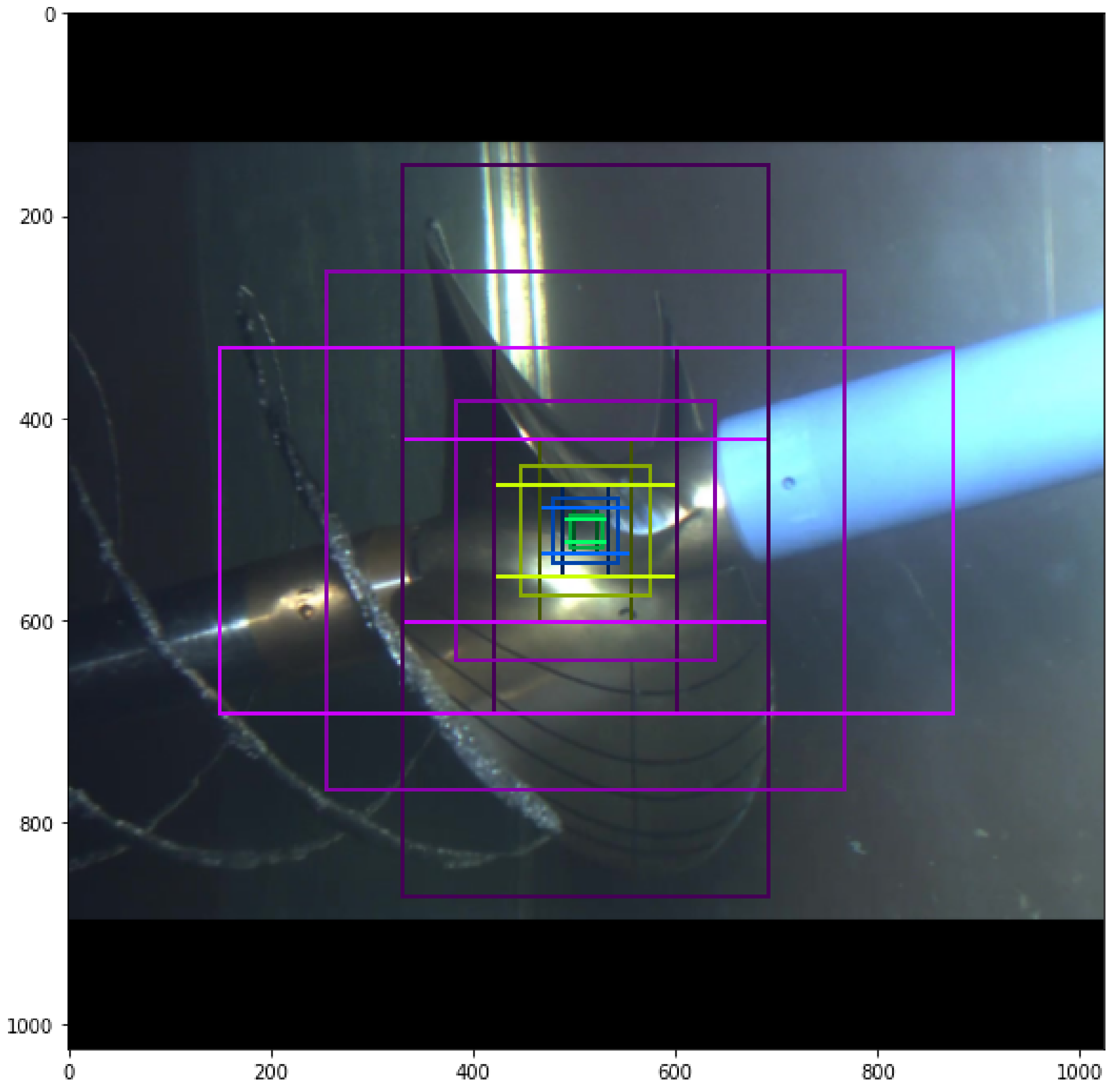
```
Count:  261888
Scales:  (32, 64, 128, 256, 512)
ratios:  [0.5, 1, 2]
Anchors per Cell:  3
Levels:  5
Anchors in Level 0: 196608
Anchors in Level 1: 49152
Anchors in Level 2: 12288
Anchors in Level 3: 3072
Anchors in Level 4: 768
```

[120]:

```
# ein zufälliges Bild zeichnen und laden
image_id = np.random.choice(dataset.image_ids, 1)[0]
image, image_meta, _, _, _ = modellib.load_image_gt(dataset, config, image_id)
fig, ax = plt.subplots(1, figsize=(10, 10))
ax.imshow(image)
levels = len(backbone_shapes)

for level in range(levels):
    colors = visualize.random_colors(levels)
    # Compute the index of the anchors at the center of the image
```

```
   level_start = sum(anchors_per_level[:level]) # sum of anchors of previous␣
↪levels
   level_anchors = anchors[level_start:level_start+anchors_per_level[level]]
   print("Level {}. Anchors: {:6}  Feature map Shape: {}".format(level,␣
↪level_anchors.shape[0],
                                                                ␣
↪backbone_shapes[level]))
   center_cell = backbone_shapes[level] // 2
   center_cell_index = (center_cell[0] * backbone_shapes[level][1] +␣
↪center_cell[1])
   level_center = center_cell_index * anchors_per_cell
   center_anchor = anchors_per_cell * (
       (center_cell[0] * backbone_shapes[level][1] / config.
↪RPN_ANCHOR_STRIDE**2) \
       + center_cell[1] / config.RPN_ANCHOR_STRIDE)
   level_center = int(center_anchor)



   for i, rect in enumerate(level_anchors[level_center:
↪level_center+anchors_per_cell]):
       y1, x1, y2, x2 = rect
       p = patches.Rectangle((x1, y1), x2-x1, y2-y1, linewidth=2,␣
↪facecolor='none',
                             edgecolor=(i+1)*np.array(colors[level]) /␣
↪anchors_per_cell)
       ax.add_patch(p)
```

```
Level 0. Anchors: 196608  Feature map Shape: [256 256]
Level 1. Anchors:  49152  Feature map Shape: [128 128]
Level 2. Anchors:  12288  Feature map Shape: [64 64]
Level 3. Anchors:   3072  Feature map Shape: [32 32]
Level 4. Anchors:    768  Feature map Shape: [16 16]
```



[121]:
```
random_rois = 2000
g = modellib.data_generator(
    dataset, config, shuffle=True, random_rois=random_rois,
    batch_size=4,
    detection_targets=True)
```

[122]:
```
if random_rois:
    [normalized_images, image_meta, rpn_match, rpn_bbox, gt_class_ids,␣
 ↪gt_boxes, gt_masks, rpn_rois, rois], \
    [mrcnn_class_ids, mrcnn_bbox, mrcnn_mask] = next(g)

    log("rois", rois)
    log("mrcnn_class_ids", mrcnn_class_ids)
    log("mrcnn_bbox", mrcnn_bbox)
    log("mrcnn_mask", mrcnn_mask)
else:
    [normalized_images, image_meta, rpn_match, rpn_bbox, gt_boxes, gt_masks], ␣
 ↪= next(g)

log("gt_class_ids", gt_class_ids)
log("gt_boxes", gt_boxes)
log("gt_masks", gt_masks)
log("rpn_match", rpn_match, )
log("rpn_bbox", rpn_bbox)
image_id = modellib.parse_image_meta(image_meta)["image_id"][0]
print("image_id: ", image_id, dataset.image_reference(image_id))


mrcnn_class_ids = mrcnn_class_ids[:,:,0]
```

```
C:\Users\majd4\anaconda3\envs\Matterprot_MaskRCNN\lib\site-
packages\skimage\transform\_warps.py:830: FutureWarning: Input image dtype is
bool. Interpolation is not defined with bool data type. Please set order to 0 or
explicitely cast input image to another data type. Starting from version 0.19 a
ValueError will be raised instead of this warning.
  order = _validate_interpolation_order(image.dtype, order)
C:\Users\majd4\anaconda3\envs\Matterprot_MaskRCNN\lib\site-
packages\skimage\transform\_warps.py:830: FutureWarning: Input image dtype is
bool. Interpolation is not defined with bool data type. Please set order to 0 or
explicitely cast input image to another data type. Starting from version 0.19 a
ValueError will be raised instead of this warning.
  order = _validate_interpolation_order(image.dtype, order)
C:\Users\majd4\anaconda3\envs\Matterprot_MaskRCNN\lib\site-
packages\skimage\transform\_warps.py:830: FutureWarning: Input image dtype is
bool. Interpolation is not defined with bool data type. Please set order to 0 or
explicitely cast input image to another data type. Starting from version 0.19 a
ValueError will be raised instead of this warning.
  order = _validate_interpolation_order(image.dtype, order)
C:\Users\majd4\anaconda3\envs\Matterprot_MaskRCNN\lib\site-
packages\skimage\transform\_warps.py:830: FutureWarning: Input image dtype is
bool. Interpolation is not defined with bool data type. Please set order to 0 or
explicitely cast input image to another data type. Starting from version 0.19 a
ValueError will be raised instead of this warning.
  order = _validate_interpolation_order(image.dtype, order)
```

```
rois                     shape: (4, 200, 4)          min:    0.00000  max:
1023.00000  int32
mrcnn_class_ids          shape: (4, 200, 1)          min:    0.00000  max:
1.00000  int32
mrcnn_bbox               shape: (4, 200, 2, 4)       min:   -3.59813  max:
3.18264  float32
```

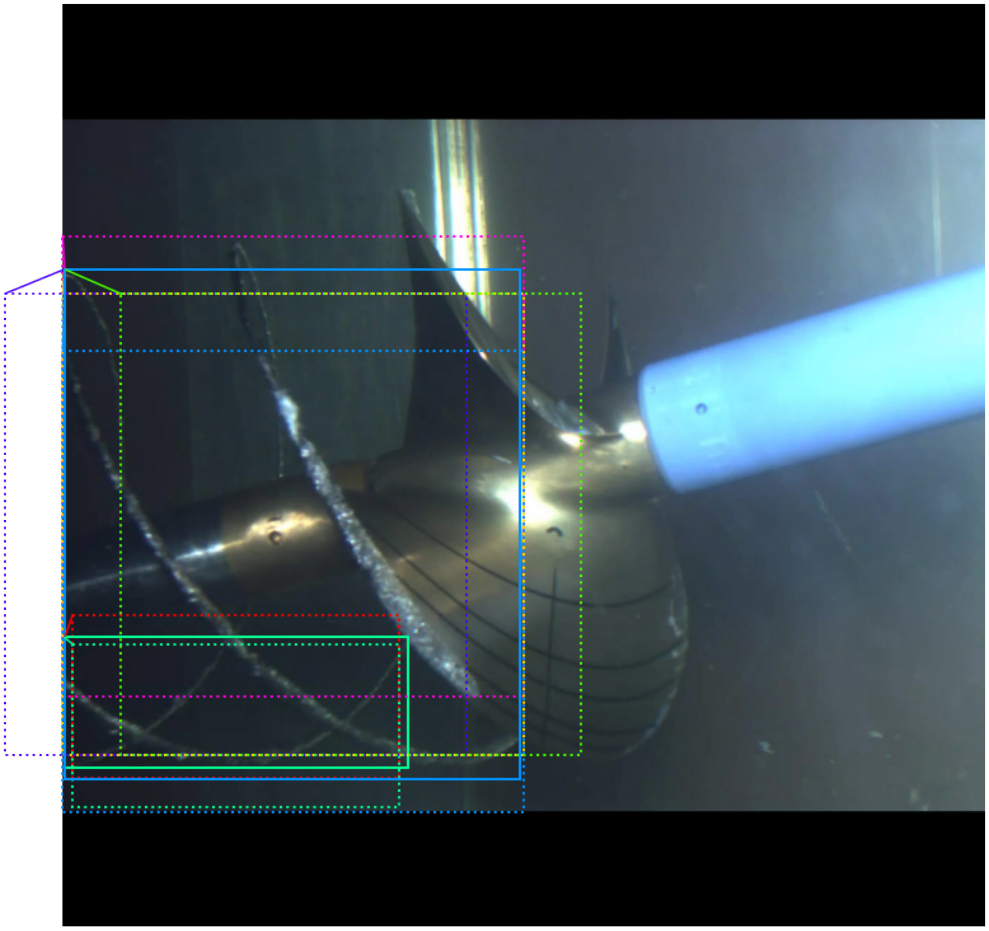
```
mrcnn_mask               shape: (4, 200, 28, 28, 2)   min:    0.00000  max:
1.00000  float32
gt_class_ids             shape: (4, 100)              min:    0.00000  max:
1.00000  int32
gt_boxes                 shape: (4, 100, 4)           min:    0.00000  max:
860.00000  int32
gt_masks                 shape: (4, 56, 56, 100)      min:    0.00000  max:
1.00000  bool
rpn_match                shape: (4, 261888, 1)        min:   -1.00000  max:
1.00000  int32
rpn_bbox                 shape: (4, 256, 4)           min:   -2.10792  max:
1.90563  float64
image_id:  19 C:\Users\majd4\Desktop\Bachelorarbeit\Bachelor-Arbeit-Daten\MaskRC
NNProjekt\MaskRCNN_2\Mask_RCNN\datasets/Tipvortexcavitation\train\Stb Gesamt0001
13-09-26 14-39-46-2 09.jpg
```

[123]:

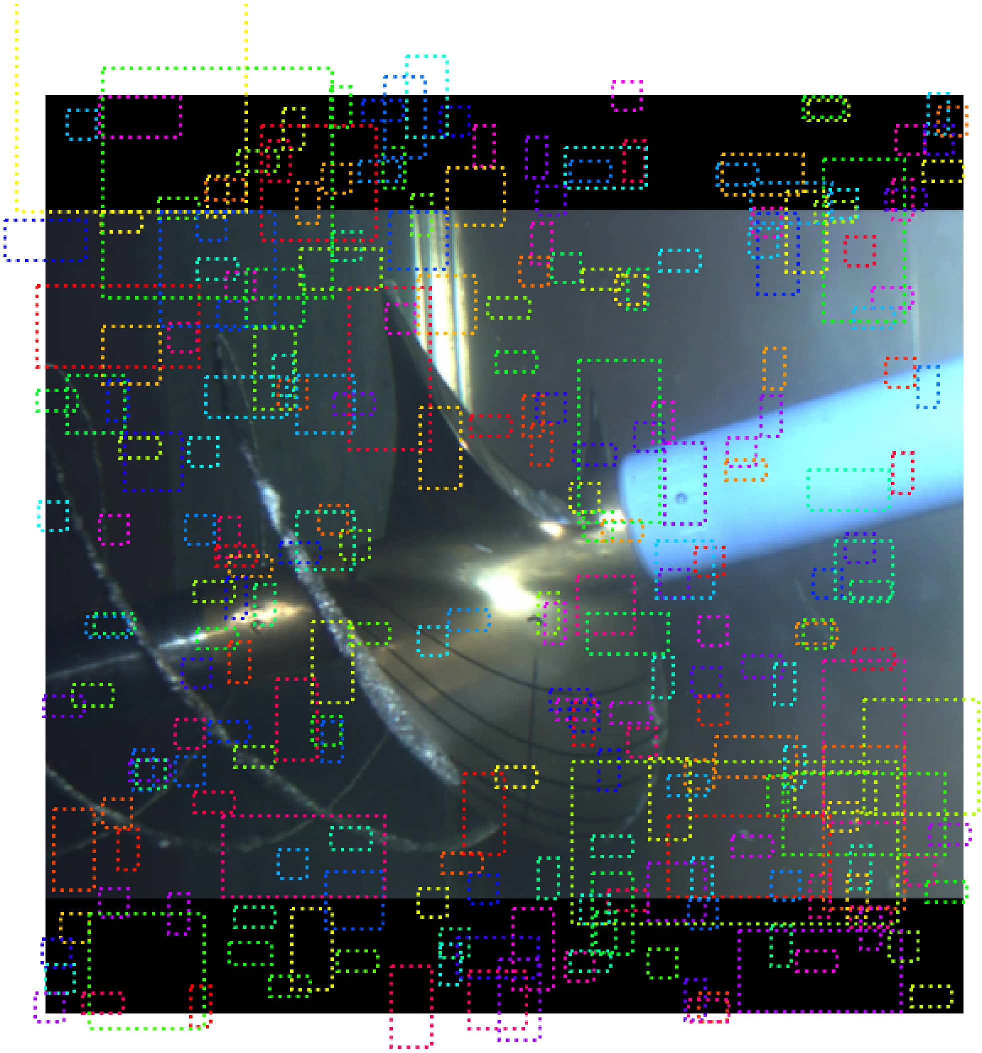
```
b = 0

# Restore original image (reverse normalization)
sample_image = modellib.unmold_image(normalized_images[b], config)

# Compute anchor shifts.
indices = np.where(rpn_match[b] == 1)[0]
refined_anchors = utils.apply_box_deltas(anchors[indices], rpn_bbox[b, :
 ↪len(indices)] * config.RPN_BBOX_STD_DEV)
log("anchors", anchors)
log("refined_anchors", refined_anchors)

# Get list of positive anchors
positive_anchor_ids = np.where(rpn_match[b] == 1)[0]
print("Positive anchors: {}".format(len(positive_anchor_ids)))
negative_anchor_ids = np.where(rpn_match[b] == -1)[0]
print("Negative anchors: {}".format(len(negative_anchor_ids)))
neutral_anchor_ids = np.where(rpn_match[b] == 0)[0]
print("Neutral anchors: {}".format(len(neutral_anchor_ids)))

# ROI breakdown by class
for c, n in zip(dataset.class_names, np.bincount(mrcnn_class_ids[b].flatten())):
    if n:
        print("{:23}: {}".format(c[:20], n))

# Show positive anchors
fig, ax = plt.subplots(1, figsize=(16, 16))
visualize.draw_boxes(sample_image, boxes=anchors[positive_anchor_ids],
                     refined_boxes=refined_anchors, ax=ax)
```

```
anchors                  shape: (261888, 4)           min: -362.03867  max:
1322.03867  float64
```

```
refined_anchors         shape: (7, 4)               min:    2.00000  max:
859.00000  float32
Positive anchors: 7
Negative anchors: 249
Neutral anchors: 261632
BG                      : 176
Tipvortexcavitation     : 24
```



[124]:
```
visualize.draw_boxes(sample_image, boxes=anchors[negative_anchor_ids])
```

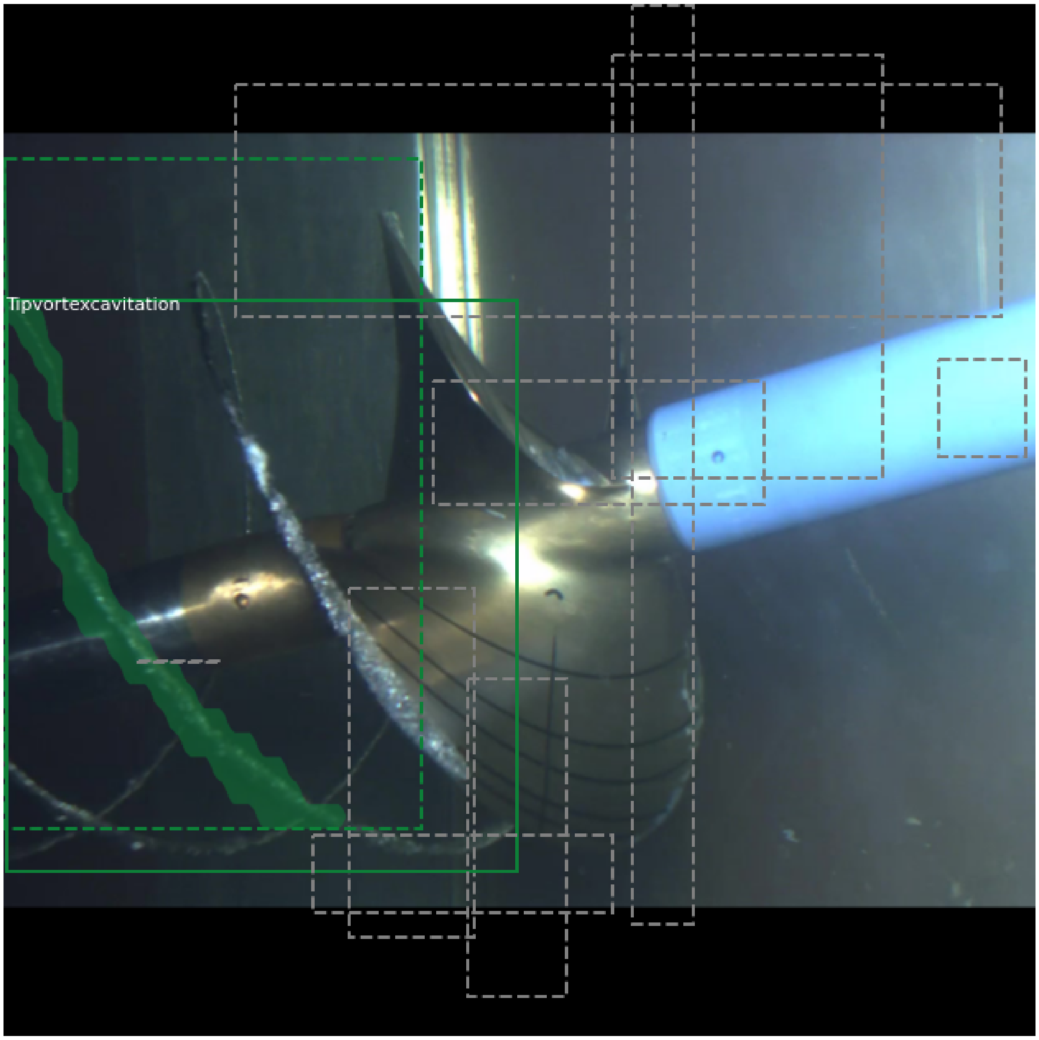


[125]:
```
if random_rois:

    bbox_specific = mrcnn_bbox[b, np.arange(mrcnn_bbox.shape[1]),␣
↪mrcnn_class_ids[b], :]


    refined_rois = utils.apply_box_deltas(rois[b].astype(np.float32),␣
↪bbox_specific[:,:4] * config.BBOX_STD_DEV)


    mask_specific = mrcnn_mask[b, np.arange(mrcnn_mask.shape[1]), :, :,␣
↪mrcnn_class_ids[b]]
```

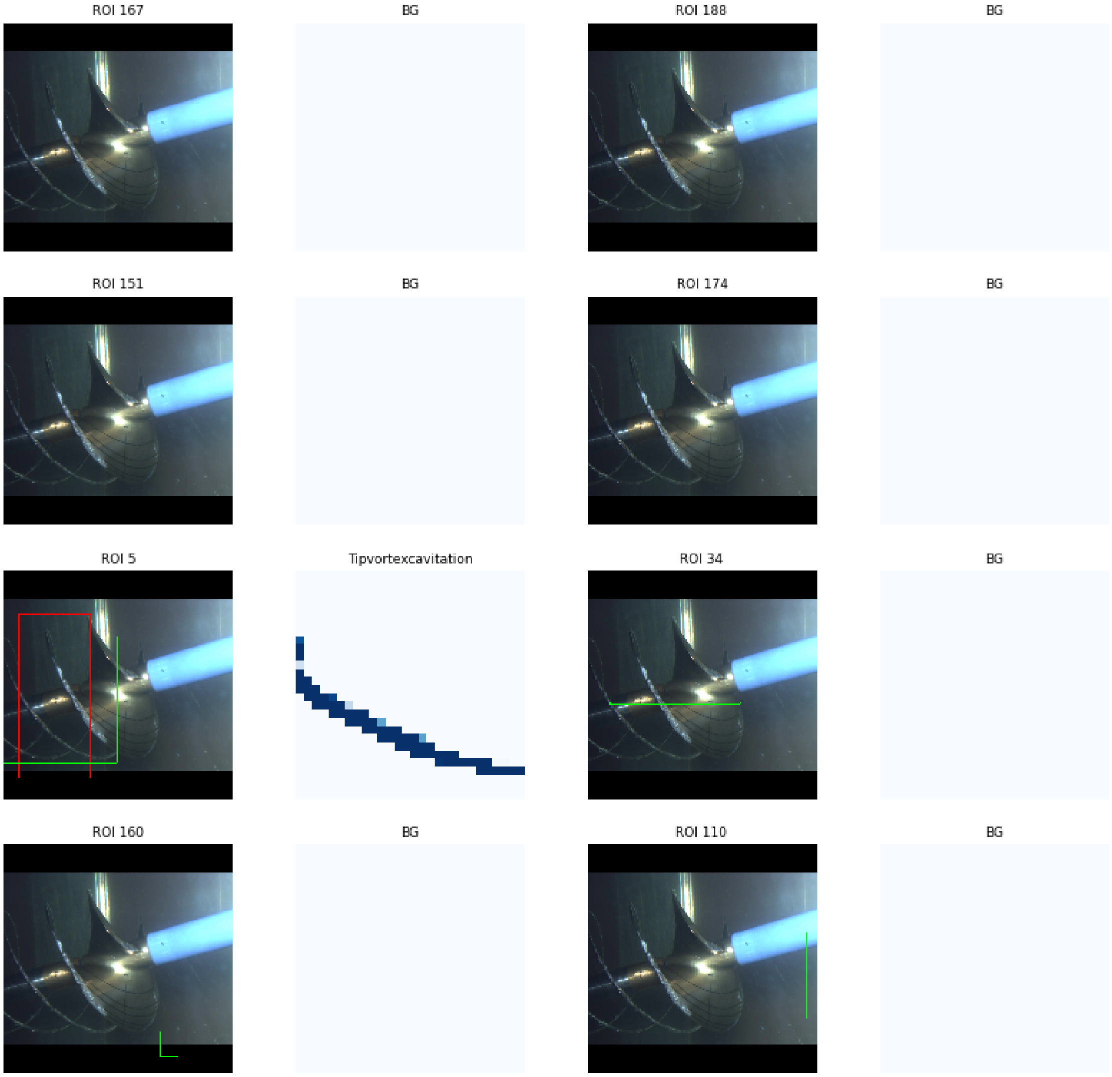
```
    visualize.draw_rois(sample_image, rois[b], refined_rois, mask_specific,␣
↪mrcnn_class_ids[b], dataset.class_names)


    rows = np.ascontiguousarray(rois[b]).view(np.dtype((np.void, rois.dtype.
↪itemsize * rois.shape[-1])))
    _, idx = np.unique(rows, return_index=True)
    print("Unique ROIs: {} out of {}".format(len(idx), rois.shape[1]))
```

```
Positive ROIs:  24
Negative ROIs:  176
Positive Ratio: 0.12
Unique ROIs: 200 out of 200
```

Showing 10 random ROIs out of 200



[126]:
```
if random_rois:

    ids = random.sample(range(rois.shape[1]), 8)

    images = []
    titles = []
    for i in ids:
        image = visualize.draw_box(sample_image.copy(), rois[b,i,:4].astype(np.
 ↪int32), [255, 0, 0])
        image = visualize.draw_box(image, refined_rois[i].astype(np.int64), [0,␣
 ↪255, 0])
        images.append(image)
        titles.append("ROI {}".format(i))
        images.append(mask_specific[i] * 255)
        titles.append(dataset.class_names[mrcnn_class_ids[b,i]][:20])

    display_images(images, titles, cols=4, cmap="Blues", interpolation="none")
```



```
[127]: if random_rois:
           limit = 10
           temp_g = modellib.data_generator(
               dataset, config, shuffle=True, random_rois=10000,
               batch_size=1, detection_targets=True)
           total = 0
           for i in range(limit):
               _, [ids, _, _] = next(temp_g)
               positive_rois = np.sum(ids[0] > 0)
               total += positive_rois
               print("{:5} {:5.2f}".format(positive_rois, positive_rois/ids.shape[1]))
           print("Average percent: {:.2f}".format(total/(limit*ids.shape[1])))
```

```
C:\Users\majd4\anaconda3\envs\Matterprot_MaskRCNN\lib\site-
```

```
packages\skimage\transform\_warps.py:830: FutureWarning: Input image dtype is
bool. Interpolation is not defined with bool data type. Please set order to 0 or
explicitely cast input image to another data type. Starting from version 0.19 a
ValueError will be raised instead of this warning.
  order = _validate_interpolation_order(image.dtype, order)

   66  0.33

C:\Users\majd4\anaconda3\envs\Matterprot_MaskRCNN\lib\site-
packages\skimage\transform\_warps.py:830: FutureWarning: Input image dtype is
bool. Interpolation is not defined with bool data type. Please set order to 0 or
explicitely cast input image to another data type. Starting from version 0.19 a
ValueError will be raised instead of this warning.
  order = _validate_interpolation_order(image.dtype, order)

   66  0.33

C:\Users\majd4\anaconda3\envs\Matterprot_MaskRCNN\lib\site-
packages\skimage\transform\_warps.py:830: FutureWarning: Input image dtype is
bool. Interpolation is not defined with bool data type. Please set order to 0 or
explicitely cast input image to another data type. Starting from version 0.19 a
ValueError will be raised instead of this warning.
  order = _validate_interpolation_order(image.dtype, order)

   66  0.33

C:\Users\majd4\anaconda3\envs\Matterprot_MaskRCNN\lib\site-
packages\skimage\transform\_warps.py:830: FutureWarning: Input image dtype is
bool. Interpolation is not defined with bool data type. Please set order to 0 or
explicitely cast input image to another data type. Starting from version 0.19 a
ValueError will be raised instead of this warning.
  order = _validate_interpolation_order(image.dtype, order)

   66  0.33

C:\Users\majd4\anaconda3\envs\Matterprot_MaskRCNN\lib\site-
packages\skimage\transform\_warps.py:830: FutureWarning: Input image dtype is
bool. Interpolation is not defined with bool data type. Please set order to 0 or
explicitely cast input image to another data type. Starting from version 0.19 a
ValueError will be raised instead of this warning.
  order = _validate_interpolation_order(image.dtype, order)

   66  0.33

C:\Users\majd4\anaconda3\envs\Matterprot_MaskRCNN\lib\site-
packages\skimage\transform\_warps.py:830: FutureWarning: Input image dtype is
bool. Interpolation is not defined with bool data type. Please set order to 0 or
explicitely cast input image to another data type. Starting from version 0.19 a
ValueError will be raised instead of this warning.
  order = _validate_interpolation_order(image.dtype, order)

   66  0.33
```

```
C:\Users\majd4\anaconda3\envs\Matterprot_MaskRCNN\lib\site-
packages\skimage\transform\_warps.py:830: FutureWarning: Input image dtype is
bool. Interpolation is not defined with bool data type. Please set order to 0 or
explicitely cast input image to another data type. Starting from version 0.19 a
ValueError will be raised instead of this warning.
  order = _validate_interpolation_order(image.dtype, order)

   66  0.33

C:\Users\majd4\anaconda3\envs\Matterprot_MaskRCNN\lib\site-
packages\skimage\transform\_warps.py:830: FutureWarning: Input image dtype is
bool. Interpolation is not defined with bool data type. Please set order to 0 or
explicitely cast input image to another data type. Starting from version 0.19 a
ValueError will be raised instead of this warning.
  order = _validate_interpolation_order(image.dtype, order)

   66  0.33

C:\Users\majd4\anaconda3\envs\Matterprot_MaskRCNN\lib\site-
packages\skimage\transform\_warps.py:830: FutureWarning: Input image dtype is
bool. Interpolation is not defined with bool data type. Please set order to 0 or
explicitely cast input image to another data type. Starting from version 0.19 a
ValueError will be raised instead of this warning.
  order = _validate_interpolation_order(image.dtype, order)

   66  0.33

C:\Users\majd4\anaconda3\envs\Matterprot_MaskRCNN\lib\site-
packages\skimage\transform\_warps.py:830: FutureWarning: Input image dtype is
bool. Interpolation is not defined with bool data type. Please set order to 0 or
explicitely cast input image to another data type. Starting from version 0.19 a
ValueError will be raised instead of this warning.
  order = _validate_interpolation_order(image.dtype, order)

   66  0.33
Average percent: 0.33
```