SmithField Pig Body Weight Progress

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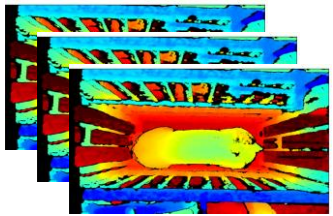
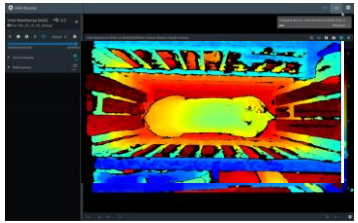
Convert .bag files into depth images



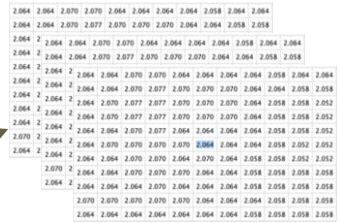
Depth images

One-to-one correspondence

Conversion



Conversion



Depth CSV files

Automated conversion in Python

```
#Author Ye Bi 10/01/2023
#this script uses rs-convert to convert .bag files inot PNG format

import os

class ConvertToPNG:

    def __init__(self):
        print('Starting Conversion')
        print('hello')

    def convert(self, inputFolder, outputFolder_depth, outputFolder_csv, toolsPath):
        #navigate to Realsense Tools
        os.chdir(toolsPath) #PATH TO \\Intel RealSense SDK 2.0\\tools\

        commandIntro = 'cmd /c '
        commandPNG = 'rs-convert -d -i '
        #iterate over files in directory

        for filename in os.listdir(inputFolder):
            if filename.endswith('.bag'):
                f = os.path.join(inputFolder, filename)
                print(filename)
                new_name = filename.split(".")[0]

                if os.path.exists(outputFolder_depth + new_name):
                    print(outputFolder_depth + new_name, "exit, go to next file \n")
                    # continue

                os.system("mkdir "+ outputFolder_depth + new_name + "\\")
                os.system("mkdir "+ outputFolder_csv + new_name + "\\")
                # fullCommandPNG = commandIntro + commandPNG + f + ' -p ' + outputFolder_depth + new_name + "\\"
                fullCommandCSV = commandIntro + commandPNG + f + ' -v ' + outputFolder_csv + new_name + "\\"
                print(fullCommandCSV)
                #convert to PNG-Depth
                # os.system(fullCommandPNG)
                # #convert to CSV
                os.system(fullCommandCSV)
```

- **Converting bag files from all data collection visits**
  - Visit 0705: 17 pens, long .bag files, 388,232 images
    - Pen#3 and Pen#5 stopped in middle.
  - Visit 0718: 19 pens, 60,389 images
  - Visit 0801: 19 pens, 91,446 images
  - Visit 0815: 19 pens, 95,776 images

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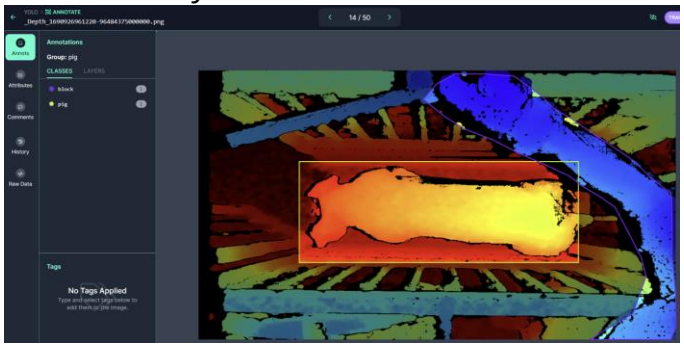
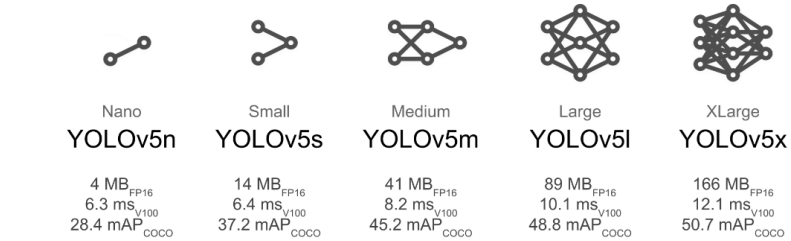
Finetuning YOLOv5

roboflow

- **Annotate image with the pig and block labels**
  - Annotated 100 images
  - Save as .yaml file



- **Select YOLOv5s as pre-training model**



- **Finetune with our customized image dataset**

```
Class     Images  Instances          P          R      mAP50   mAP50-95:   0%|          | 0/1 [00:00<?, ?it/s]
Class     Images  Instances          P          R      mAP50   mAP50-95: 100%|██████████| 1/1 [00:00<00:00, 10.87it/s]
  all         11         13      0.851      0.878      0.916      0.617
block         11          8      0.858      0.757      0.836      0.459
  pig         11          5      0.844          1      0.995      0.776
```

https://docs.ultralytics.com/yolov5/tutorials/train_custom_data/

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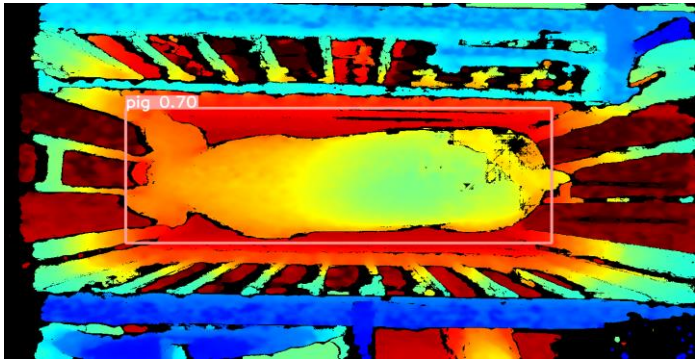
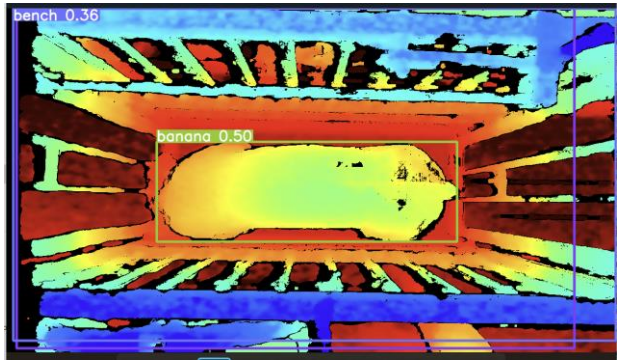
Preprocessing with finetuned YOLOv5

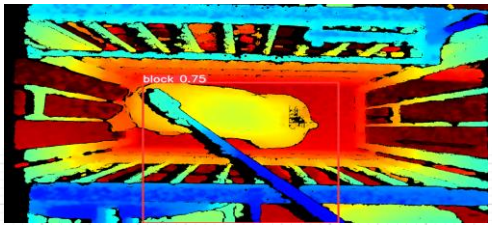
- **YOLO with finetune**
  - Recognized the pig successfully

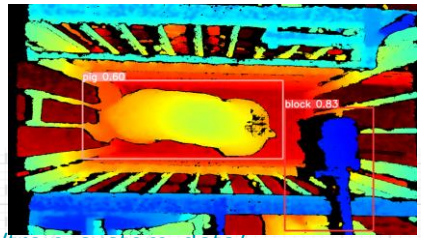


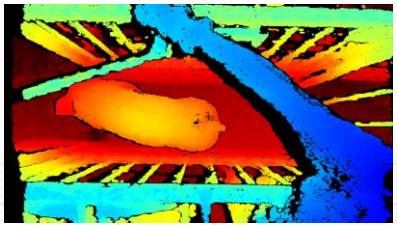
- **YOLO without finetune**
  - Recognized as a banana or cake

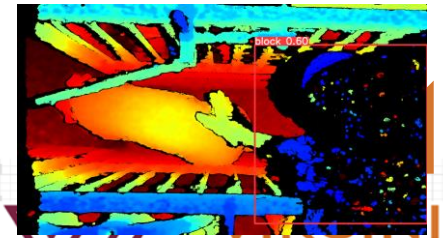


- **Images that did not pass YOLO:** **How to define not good images**
  - Block detect rate > 0.1
  - Pig detect rate < 0.5
  - No detection





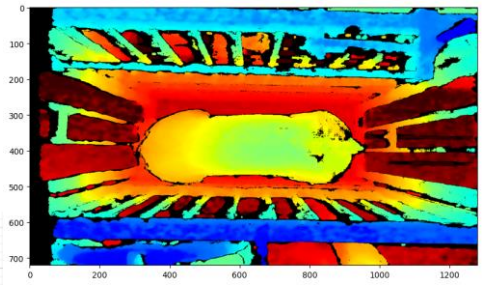




https://docs.ultralytics.com/yolov5/tutorials/train_custom_data/

Dataset used for data analysis

- Day: 08/01/2023
- Pens: 19 pens
- Pigs: 608 pigs
- Depth images: 91,446



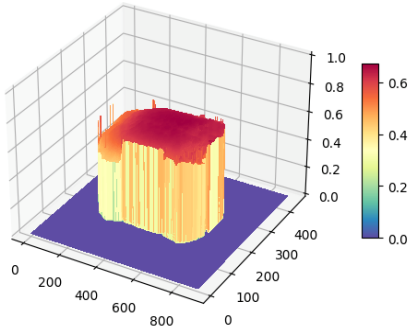


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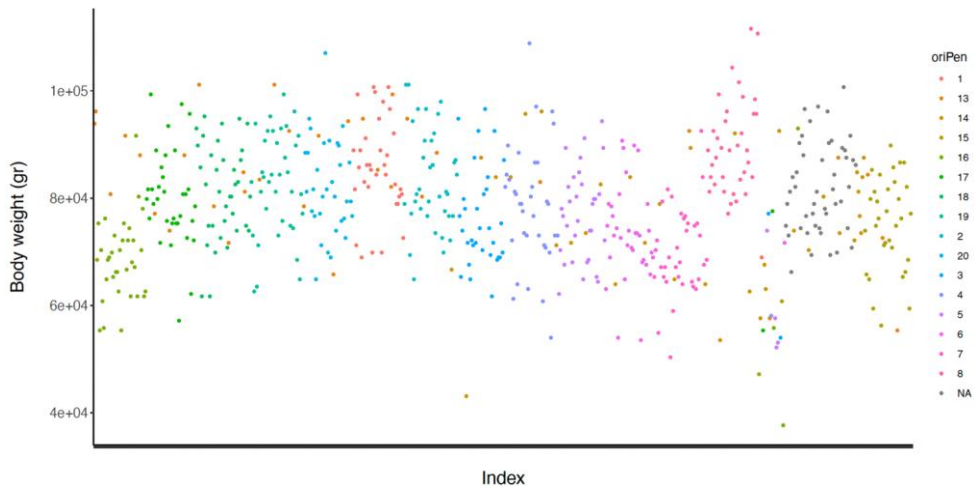
Image analysis results

Name	Date Modified
0801_pen1top_20230801_135853.csv	Today at 4:53 PM
0801_pen1top_20230801_135940.csv	Today at 4:50 PM
0801_pen1top_20230801_140001.csv	Today at 4:09 PM
0801_pen1top_20230801_140026.csv	Today at 4:09 PM
0801_pen1top_20230801_140050.csv	Today at 4:09 PM
0801_pen1top_20230801_140122.csv	Today at 4:09 PM
0801_pen1top_20230801_140144.csv	Today at 4:09 PM
0801_pen1top_20230801_140408.csv	Today at 4:09 PM
0801_pen1top_20230801_140450.csv	Today at 4:10 PM
0801_pen1top_20230801_140509.csv	Today at 4:10 PM
0801_pen1top_20230801_140532.csv	Today at 4:10 PM
0801_pen1top_20230801_140612.csv	Today at 4:10 PM
0801_pen1top_20230801_140625.csv	Today at 4:10 PM
0801_pen1top_20230801_140655.csv	Today at 4:10 PM
0801_pen1top_20230801_141038.csv	Today at 4:11 PM
0801_pen1top_20230801_141101.csv	Today at 4:11 PM
0801_pen1top_20230801_141134.csv	Today at 4:53 PM
0801_pen1top_20230801_141202.csv	Today at 4:11 PM
0801_pen1top_20230801_141218.csv	Today at 4:11 PM
0801_pen1top_20230801_141238.csv	Today at 4:12 PM
0801_pen1top_20230801_141302.csv	Today at 4:12 PM



	A	B	C	D	E	F	G	H	I
1	Day	Pen	Bag_ID	Frame	Width	Length	Height_Centroid	Height_average	Volume
2	801	pen1top	20230801_141101	_Depth_1690913465038.92797851562500	228	687.711	0.681	0.615843881	77588.32303
3	801	pen1top	20230801_141101	_Depth_1690913465705.77075195312500	221	624	0.664	0.613117737	72168.8626
4	801	pen1top	20230801_141101	_Depth_1690913466372.67968750000000	219	639	0.666	0.614580783	72728.2607
5	801	pen1top	20230801_141101	_Depth_1690913467039.91943359375000	221	652.737	0.667	0.614053832	72891.26014
6	801	pen1top	20230801_141101	_Depth_1690913467708.10278320312500	235	616.001	0.657	0.607008001	70693.97287
7	801	pen1top	20230801_141101	_Depth_1690913468375.61669921875000	229	646.094	0.654	0.60633581	72730.58679
8	801	pen1top	20230801_141101	_Depth_1690913469042.90405273437500	230	642.012	0.659	0.609272468	72928.08662
9	801	pen1top	20230801_141101	_Depth_1690913469710.04931640625000	226	635.133	0.666	0.614482492	72661.32573
10	801	pen1top	20230801_141101	_Depth_1690913470377.22949218750000	224	668.091	0.669	0.614794654	75911.15514
11	801	pen1top	20230801_141101	_Depth_1690913471044.40795898437500	223	692.003	0.661	0.624762821	76407.2435
12									

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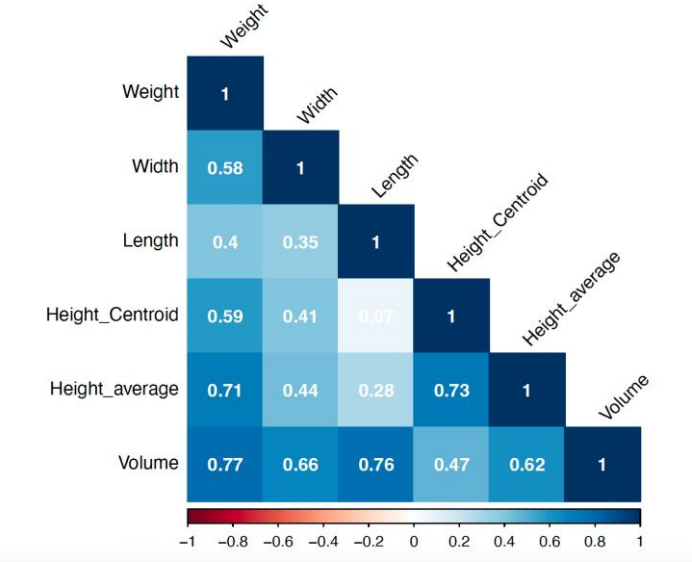
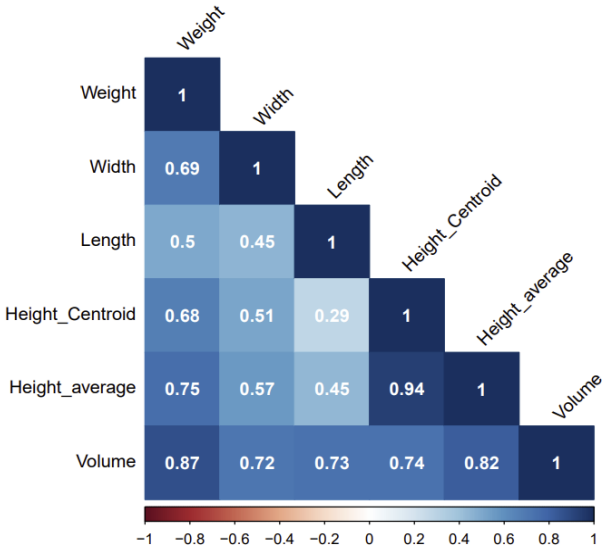
Preliminary Result: Heatmap of Correlation Coefficients



- **Before YOLO preprocessing + half pens**
- **Multiple linear regression R-square: 0.72**



- **After YOLO preprocessing + all pens**
- **Multiple linear regression R-square: 0.81**

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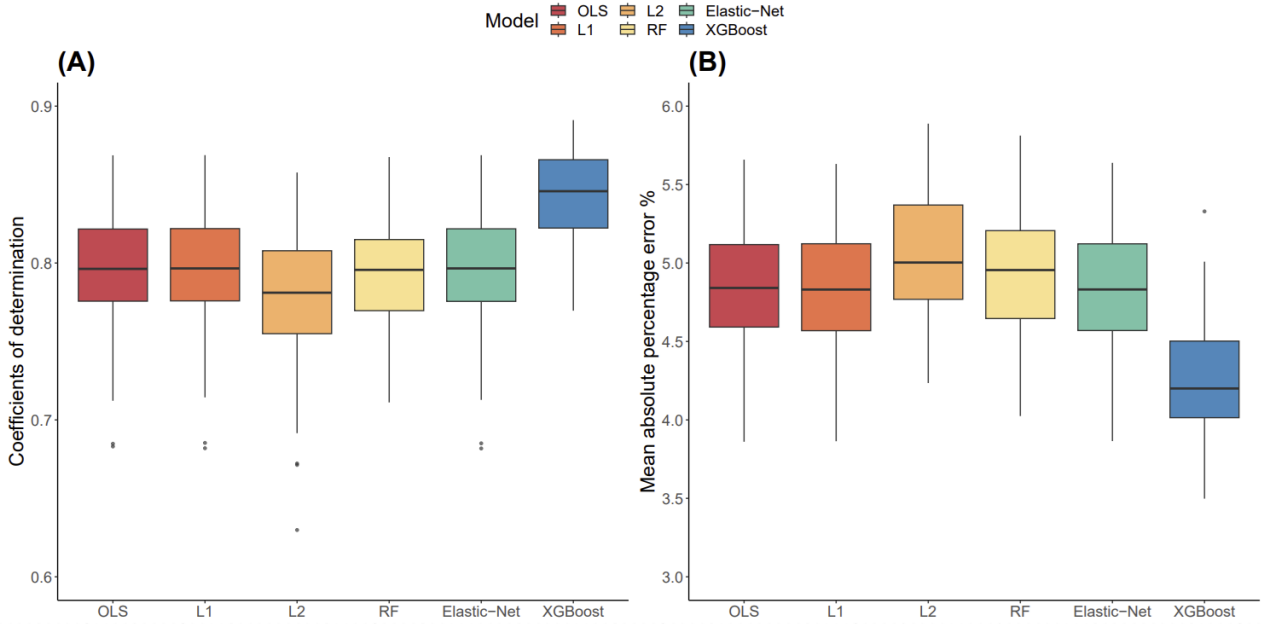
Cross-validation prediction

Random repeated subsampling cross-validation: 80% training, 20% testing, 100 repeats



Coefficient of determination

MAPE

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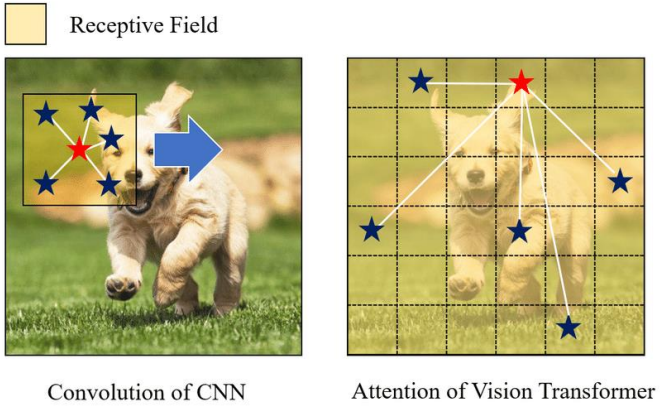
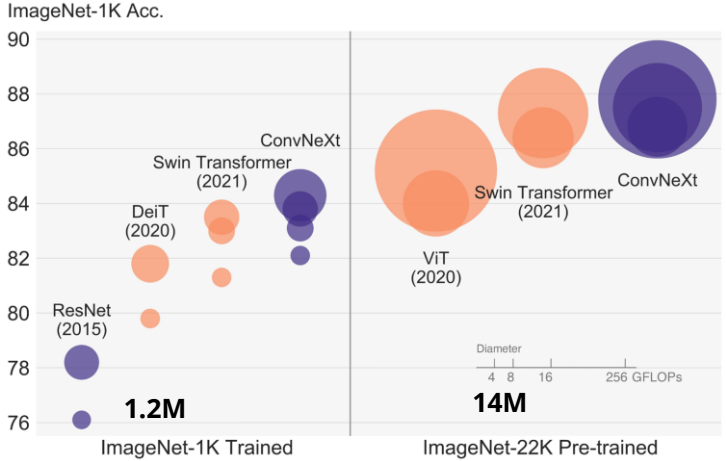
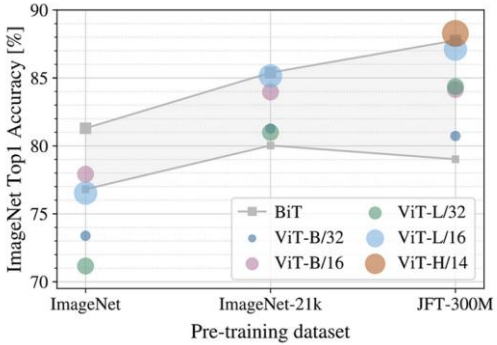
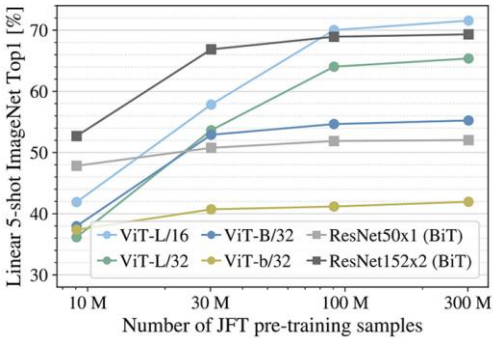
Compare CNN with Vision Transformer





Liu, Zhuang, et al. "A convnet for the 2020s." Proceedings of the IEEE/CVF conference on computer vision and pattern recognition. 2022.





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