Hardware Requirements: Windows. You will also need a relatively powerful computer with a NVIDIA GPU: The computer that this model was run on has a NVIDIA GeForce RTX 4090 GPU with 16GB of vRAM. The computer itself has 64 GB of RAM and the processor is a 13th Gen Intel(R) Core(TM) i9-13900H, 2.60 GHz.

Software Requirements: SonarWiz, ArcGIS Pro

Knowledge requirements: Basic proficiency in Python, Command Prompt, ArcGISPro, SonarWiz.

Notes: File names and upper/lower case must match exactly for these commands to work. In general, when working with Python, it’s best to use filenames that have no spaces.

**To Test Existing Model on New Data**

1. Install Anaconda
   1. https://docs.anaconda.com/free/anaconda/install/windows/
2. Create (two) virtual environments
   1. Open Anaconda Prompt
   2. For the first virtual environment type: conda create -n yolov7\_custom python = 3.9
      1. Press Enter and when asked whether you wish to proceed, type: y
   3. For the second virtual environment type: conda create –name Preprocess
   4. Press Enter and when asked whether you wish to proceed, type: y
   5. Activate the first environment you created by typing: conda activate yolov7\_custom
3. Installing pre-reqs for YOLOv7
   1. Save the YOLOv7\_Custom folder on your hard drive. It contains yolov7-custom.
   2. Navigate to the folder location on your hard drive for yolov7-custom and copy the path. For example, on my machine it’s *C:\Users\Leila\Documents\GitHub\YOLOv7\_Custom\yolov7-custom*
      1. In Anaconda Prompt, type “cd” followed by a space and the path you just copied.
      2. Type: pip install -r requirements.txt
      3. Once all the installs are finished, type in: pip install -r requirements\_gpu.txt
4. Generate new test data. Note: Refer to file structure document in Deliverables folder for suggested file structure for data generated in this section (1bFileStructureDetailsforYOLOv7InstallandTestonNewData.docx).
   1. On your hard drive, create the following folders: SonarWizMosaics, ArcGISProTiles, JPEG, TIFF.
   2. For each sonar mosaic, generate two tiff mosaics in SonarWiz: one with odd-numbered rows and one with even-numbered rows. Image resolution should be 0.10 meters. Set the background color to light blue. Save the mosaics in the SonarWizMosaics folder. Below is an example of export settings dialogue box:

A screenshot of a computer

Description automatically generated

* 1. Add mosaics to ArcGIS Pro project.
  2. Adjust the symbology. Leave the first three bands (RGB) as-is. Set the alpha band to “None.” Set “Stretch Type” to “None” and all three gamma values to 1.0.
  3. Open the Geoprocessing Tool “Export Training Data for Deep Learning”
     1. For each of your mosaics: Select your input raster. Create an output folder named based on the input raster and save it inside of the ArcGISPro Tiles folder. Image format should be TIFF. Tile Size X and Y should both be 640. Stride X and Y should both be 640. Metadata format should be KITTI. Run tool.
  4. In Anaconda Navigator on the Home screen, select your “Preprocess” virtual environment that you created in Step 2 of this document. See images below.
     1. Scroll through the applications until you find Jupyter Notebook and click “Install.”
     2. Once Jupyter Notebook has finished installing, click on “Environments” in the left sidebar.
     3. Remaining in the “Preprocess” virtual environment, search for “All” and type “pillow” in the search at far right. Check the box and click “Apply” to install.

A screenshot of a computer

Description automatically generated

A screenshot of a computer

Description automatically generated

* 1. After Pillow has finished installing, go back to Anaconda Navigator home and launch Jupyter Notebook, still using the Preprocess environment.
     1. In the Deliverables folder, open MoveFiles.ipynb.
        1. Your root directory should be your path to ArcGISProTiles. Your target folder should be your TIFF folder. Make sure if name.endswith (‘tif’) says ‘tif’ and not something else (for instance, ‘txt’).
        2. Click “Run” in the menu at the top of the screen and then “Run All Cells.” All the tiff files should now be together in TIFF.
  2. The tiff files now need to be converted to JPEG for the model. In Jupyter Notebook, in the Deliverables folder, open ConvertTIFtoJPEG.ipynb.
     1. In the second text box, change the file path to the TIFF folder. You will need to make sure that the path contains forward slashes (/). If it defaults to backslashes (\), then click “Edit” in the menu at the top of the screen and then “Find” and “Replace” to find \ and replace with /.
     2. Click “Run” in the menu at the top of the screen and then “Run All Cells.”

1. Go to your TIFF folder and click “View.” Select “Details” to then filter by type of file. Cut all the .jpeg files and move them into the JPEG folder.
2. In your newly created JPEG folder, click “View.” Select “Details” and then filter by size. Then click “View” and select “Large icons.”
   * 1. Scroll down until the images don’t contain any actual sonar image and just white, black, or blue background color. Delete all files that don’t contain sonar data. It will be all files that are less than or equal to, approximately, 6 KB.
3. Testing model on new data
   1. Put your newly created JPEG folder in the testdata folder in yolov7-custom. NOTE: On the computer that this model was run, the maximum number of tiles that the model could be tested on at once (without the model crashing) was 2400. In this case, the test data must be run in batches of 2400.
   2. Copy the path to the folder containing the new data
   3. In Anaconda Prompt, type: python detect.py --weights yolov7\_custom.pt --conf 0.5 --img-size 640 --source [path to folder containing new data] --view-img --no-trace --save-txt
   4. The results will be output into …YOLOv7\_Custom\yolov7-custom\runs\detect
4. Accuracy assessment
   1. Copy the path to your labels folder for the new data you just ran the model on in runs\detect. It should be something like this …YOLOv7\_Custom\yolov7-custom\runs\detect\[exp…]\labels
   2. In Command Prompt (Windows Command Prompt, not Anaconda Prompt), type “cd” followed by a space and the path you just copied.
   3. Type “dir>Detections.txt” to create a text file of all the predicted detections output by the model. The file will be output within the labels directory.
   4. Open created txt file in Excel as space delimited and delete data so that file consists a single column containing “[file name].jpg. You will have to find and replace .txt with .jpg.
   5. Save this file and save a copy of this file in the “detect” folder.
   6. In the Deliverables folder, open the document called Powershell\_RemoveFiles.txt
      1. The first file path should be the path to the original Detections.txt in the labels folder.
      2. The second file path should be to all the output results images one level up from the labels file. For example:

$files = Get-Content "C:\Users\Leila\Documents\GitHub\YOLOv7\_Custom\yolov7-custom\runs\detect\exp\labels\Detections.txt";$location = "C:\Users\Leila\Documents\GitHub\YOLOv7\_Custom\yolov7-custom\runs\detect\exp"; Get-ChildItem -Recurse $location -File -Exclude $files | Remove-Item;

* + 1. Copy your edited command from the txt document and paste in Powershell. Press enter. Now you should only have images with predicted model detections in the output results images folder.
  1. You can assess prediction accuracy at this point by looking at predicted model detections, however there is another process required to view predicted detections geospatially. This step is required to see where in a given sonar swath a prediction is located or to get coordinates for the prediction.
     1. Navigate to the TIFF folder that contains all your tiff files that you generated during section 4 of this document, Generate new test data. These files should be the tiff equivalent of the jpegs that you just tested the model on.
     2. To edit this file to only contain the tiff files that contain predicted detections based on model output, open your copy of Detections.txt from step 6e in Excel. Find and replace .jpg with .tiff.
     3. Save this file.
     4. In the Deliverables folder, open the document called Powershell\_RemoveFiles.txt.
        1. The first file path should be the path to the copy of the Detections.txt in the “detect” folder.
        2. The second file path should be to the TIFF folder containing all of your tiff files from i. above.
        3. Copy your edited command from the txt document and paste in Windows Powershell. Press enter. Now you should only have images with predicted model detections in the TIFF folder.
  2. You can now add the remaining tiff tiles to an ArcGIS Pro project and create a point feature class representing model predictions that may be interesting to ground truth.
     1. You may need to compare the tiff tiles to the model output prediction bounding box jpeg images in the “detect” folder.
  3. You can import point feature classes as shapefiles into SonarWiz to get more information about the point, such as depth.
     1. You will need to label all imported points as contacts in SonarWiz.