**PART-A (About 2-3 Pages)**

**Format for Micro-Project Proposal**
**For 1st to 4th Semester**

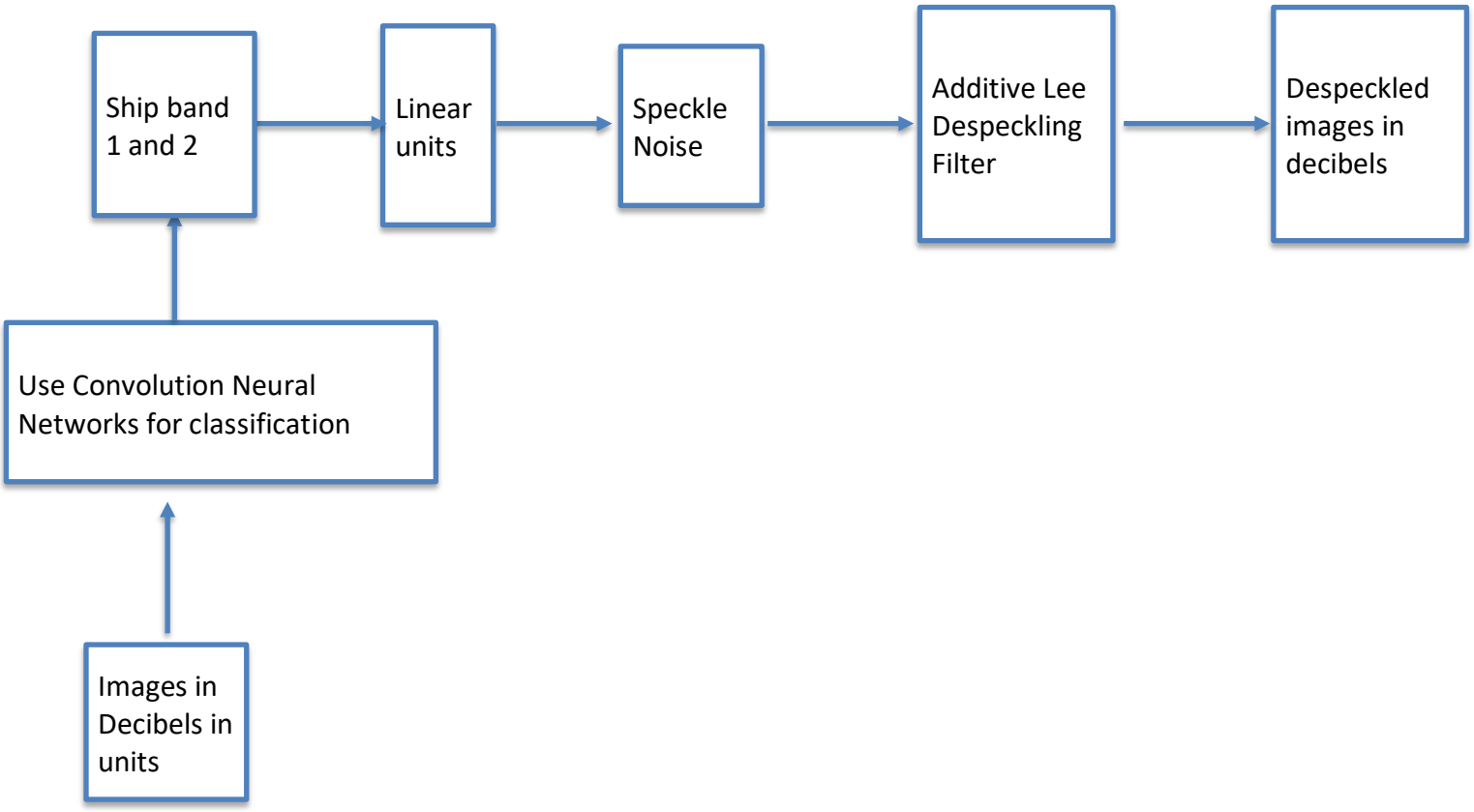
**Title of Micro Project:**

Despeckling Synthetic Aperture Radar (SAR) Images

**1.0 Brief Introduction: (Importance of the Project, in about 4 to 5 sentences)**

- SAR stands for Synthetic Aperture Radar
- Uses microwave-frequency light to actively image surface features
- For example, the satellites of the ESA's Sentinel-1 mission emit C-band (4 to 8 Ghz) radiation and analyze the returning backscatter of this radiation off of surface features to create a map of those features.

CONCEPT



**2.0 Aim of the Micro Project (in about 4 to 5 sentences)**

In remote areas with particularly harsh weather the only viable monitoring option is via satellite. To keep operations safe and efficient, how machine learning can be used more accurately to detect and discriminate against threatening icebergs and get accurate satellite images of the same using despeckling techniques.

**3.0 Action Plan (Sequence and time required for major activities for 8 weeks)**

| Sr. No. | Details of Activity | Planned Start Date | Planned Finish Date | Name of Responsible Team Members |
|---|---|---|---|---|
| 1 | Presenting the topic | 25/6/20 | 25/6/20 | Sania Bandekar |
| 2 | Data analysis | 27/6/20 | 29/6/20 | Sania Bandekar |
| 3 | Classifying the data | 30/6/20 | 30/6/20 | Sania Bandekar |
| 4 | Noise removal from data | 27/7/20 | 30/7/20 | Sania Bandekar |
| 5 | Data visualization | 27/8/20 | 30/9/20 | Sania Bandekar |

**4.0 Resources Required (Such as raw material, some machining facility, software etc.)**

| Sr. No. | Name of Resource/Material | Specifications | Qty | Remarks |
|---|---|---|---|---|
| 1 | Scipy | Packages | N/A | N/A |
| 2 | • Statoil /C-CORE Iceberg Classifier Challenge training dataset(train.json) | 80% of data | N/A | N/A |
| 3 | • Statoil /C-CORE Iceberg Classifier Challenge testing dataset(test.json) | 20% of data | N/A | N/A |
| 4 | Kaggle kernel | Notebook | N/A | N/A |
| 5 | Sample.csv | sample data | N/A | N/A |

Annexure-IA

**PART-B (Outcomes after Execution and Format for Micro-Project Report, About 6-10 Pages)**
**For 1st to 4th Semester**

**Title of Micro Project:**

Despeckling Synthetic Aperture Radar (SAR) Images

**1.0 Brief Description: (Importance of the project, in about 100 to 200 words)**

- SAR stands for Synthetic Aperture Radar
- Uses microwave-frequency light to actively image surface features
- For example, the satellites of the ESA's Sentinel-1 mission emit C-band (4 to 8 Ghz) radiation and analyze the returning backscatter of this radiation off of surface features to create a map of those features.
- Image processing techniques to reduce speckle noise are called despeckling techniques.
- Speckle noise in the iceberg/ship dataset of the Statoil /C-CORE Iceberg Classifier Challenge and employ a filter called the Lee Filter to reduce this noise.
- Convolutions are necessary because a neural network has to be able to interpret the pixels in an image as numerical values. The function of the convolutional layers is to convert the image into numerical values that the neural network can interpret and then extract relevant patterns from. The job of the filters in the convolutional network is to create a two-dimensional array of values that can be passed into the later layers of a neural network, those that will learn the patterns in the image.
- Accuracy of the model is 95%.

Images in decibels are converted to linear units .The raw image band data is given in units of decibels, so I'll convert to linear units assuming the raw data is given by:
Z(dB) = 10 log10(Z/Z_0) and Z_0 is 1.
The target variable, set to 1 if it is an iceberg, and 0 if it is a ship. This field only exists in train.json.
I have included machine-generated images in the test set to prevent hand labeling.
They are excluded in scoring.despeckling noise is additive with a constant mean of zero, a constant variance, and drawn from a Gaussian distribution. Use a window (I x J pixels) to scan the image with a stride of 1 pixels (and I will use reflective boundary conditions). The despeckled value of the pixel in the center of the window located in the ith row and jth column is, zhat_ij = mu_k + W*(z_ij = mu_z), where mu_k is the mean value of all pixels in the window centered on pixel i,j, z_ij is the unfiltered value of the pixel, and W is a weight calculated as, W = var_k / (var_k + var_noise), where var_k is the variance of all pixels in the window and var_noise is the variance of the speckle noise. A possible alternative to using the actual value of the center pixel for z_ij is to use the median pixel value in the window.
The parameters of the filter are the window/kernel size and the variance of the noise (which is unknown but can perhaps be estimated from the image as the variance over a uniform feature smooth like the surface of still water). Using a larger window size and noise variance will increase radiometric resolution at the expense of spatial resolution.

**2.0 Aim of Micro Project: (in about 100 to 200 words)**

Drifting icebergs present threats to navigation and activities in areas such as offshore of the East Coast of Canada.In remote areas with particularly harsh weather the only viable monitoring option is via satellite. To keep operations safe and efficient, how machine learning can be used more accurately to detect and discriminate against threatening icebergs and get accurate satellite images of the same using despeckling techniques.

Consequences of using microwave-frequency light to image surface features:

- Features being imaged often have a roughness with length scales similar to the wavelength of the light being used (4 to 8 cm).
- Backscattered light will experience mutual interference creating speckle noise.
- Speckle noise presents itself as patches that are lighter or darker than they otherwise would be based on the features being imaged.
- Image processing techniques to reduce speckle noise are called despeckling techniques.
- The Lee filter reduces the speckle noise by applying a spatial filter to each pixel in an image, which filters the data based on local statistics calculated within a square window. The value of the center pixel is replaced by a value calculated using the neighboring pixels.

**3.0 Course Outcomes Integrated (Add to the earlier list if more CO's are addressed)**

- Interpret Radar based systems for range detection
- Maintain various types of radar systems for specific applications.
- Maintain active microwave components and passive microwave components.
- Interpret data using Data analysis
- Perform data visualization

**4.0 Actual Procedure followed**

(Write stepwise the work done, including team member did what work and how the data was analyzed, if any)

- Presenting the topic
- Data analysis-All the images are 75x75 images with two bands.Data fields- train.json, test.json-is presented in json (JavaScript Object Notation) format.The files consist of a list of images, and for each image, parameters like: id - the id of the image, band_1, band_2 - the flattened image data.

Each band has 75x75 pixel values = 5625 elements; float numbers with unit being dB. Band 1 and Band 2 are signals characterized by radar backscatter, inc_angle - the incidence angle of which the image was taken. , is_iceberg - the target variable, set to 1 if it is an iceberg, and 0 if it is a ship. This field only exists in train.json.Test data - Machine-generated images excluded in scoringTraining data - field has missing data marked as "na", and those images with "na" incidence angles.Train/Test is a method to measure the accuracy of your model.It is called Train/Test because you split the the data set into two sets: a training set and a testing set.80% for training, and 20% for testing.

- Classifying the data using CNN-Convolutions are necessary because a neural network has to be able to interpret the pixels in an image as numerical values. The function of the convolutional layers is to convert the image into numerical values that the neural network can interpret and then extract relevant patterns from. The job of the filters in the convolutional network is to create a two-dimensional array of values that can be passed into the later layers of a neural network, those that will learn the patterns in the image.Accuracy of the model is 95%.

- Noise removal from data-Let's assume that the despeckling noise is additive with a constant mean of zero, a constant variance, and drawn from a Gaussian distribution. Use a window (I x J pixels) to scan the image with a stride of 1 pixels (and I will use reflective boundary conditions). The despeckled value of the pixel in the center of the window located in the ith row and jth column is, zhat_ij = mu_k + W*(z_ij = mu_z), where mu_k is the mean value of all pixels in the window centered on pixel i,j, z_ij is the unfiltered value of the pixel, and W is a weight calculated as, W = var_k / (var_k + var_noise), where var_k is the variance of all pixels in the window and var_noise is the variance of the speckle noise. A possible alternative to using the actual value of the center pixel for z_ij is to use the median pixel value in the window.The parameters of the filter are the window/kernel size and the variance of the noise (which is unknown but can perhaps be estimated from the image as the variance over a uniform feature smooth like the surface of still water). Using a larger window size and noise variance will increase radiometric resolution at the expense of spatial resolution.

- Data visualisation- Scipy packages are used. The visualization of data is done through the dataset radar images.

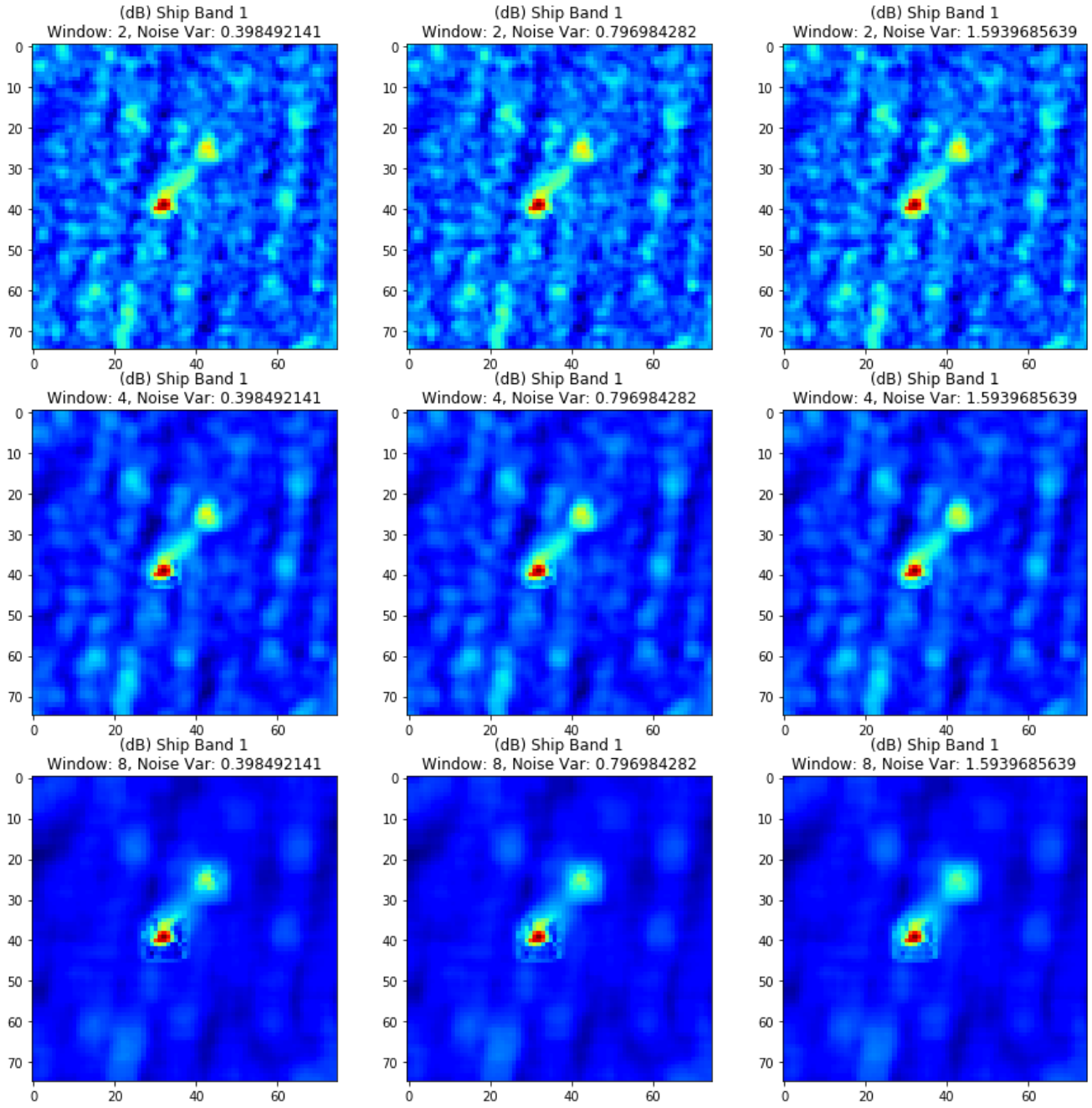
**5.0 Actual Resources Used: (Mention the actual resources used)**

| Sr. No. | Name of Resource/Material | Specifications | Qty | Remarks |
|---|---|---|---|---|

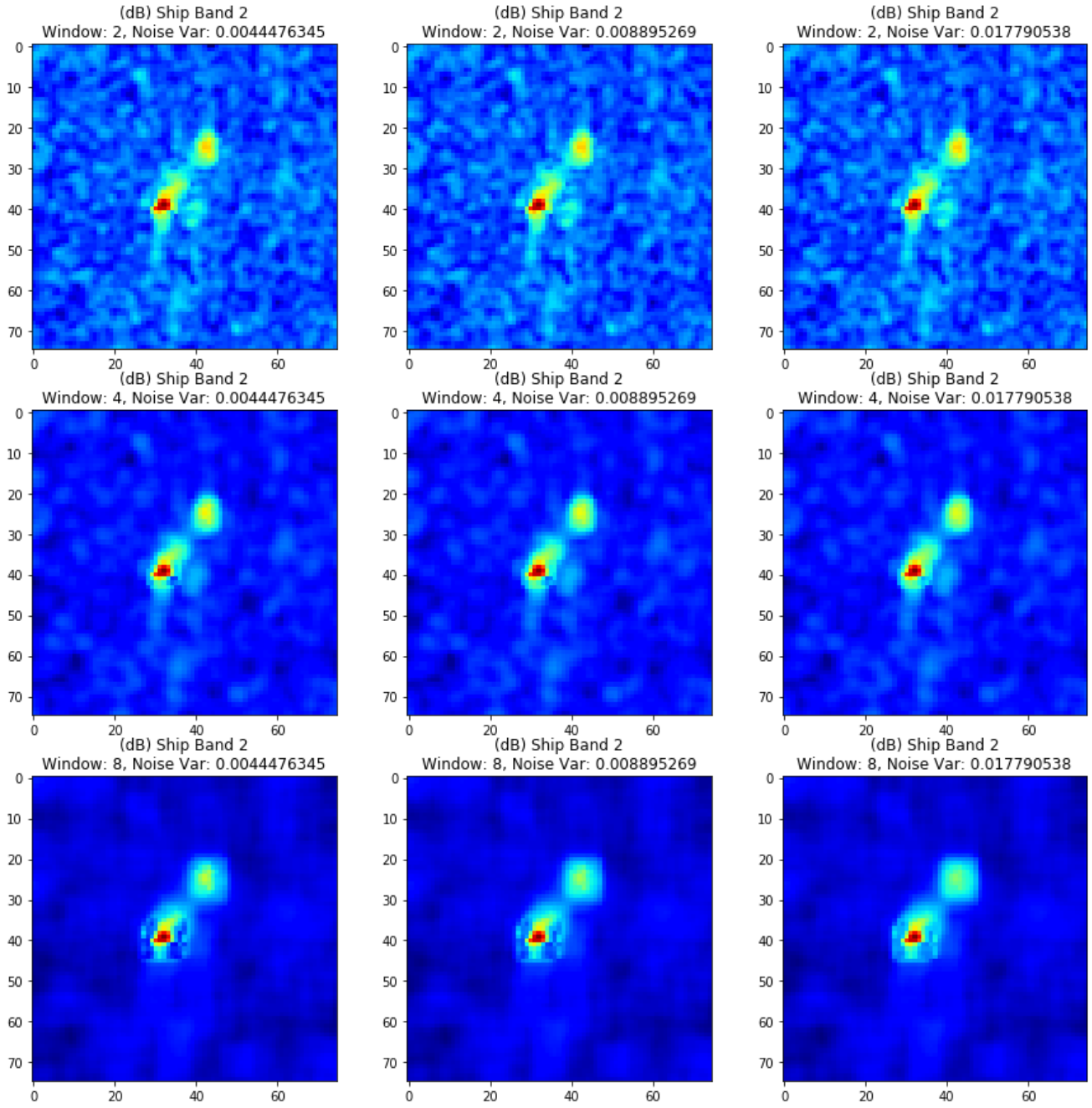
| | | | | |
|---|---|---|---|---|
| 1 | Scipy | Packages | N/A | N/A |
| 2 | • Statoil /C-CORE Iceberg Classifier Challenge training dataset(train.json) | 80% of data | N/A | N/A |
| 3 | • Statoil /C-CORE Iceberg Classifier Challenge testing dataset(test.json) | 20% of data | N/A | N/A |
| 4 | Kaggle kernel | Notebook | N/A | N/A |
| 5 | Sample.csv | sample data | N/A | N/A |

**6.0 Outputs of the Micro Projects**

Ship band 1 in db units




Ship band 2 in db units




**7.0 Skill Developed/Learning out of this Micro Project** (In about 150 to 300 words)

- Using Convolution Neural networks for image processing.Convolutions are necessary because a neural network has to be able to interpret the pixels in an image as numerical values. The function of the convolutional layers is to convert the image into numerical values that the neural network can interpret and then extract relevant patterns from. The job of the filters in the convolutional network is to create a two-dimensional array of values that can be passed into the later layers of a neural network, those that will learn the patterns in the image.Accuracy of the model is 95%.

- Using Lee filter for Noise removal.The Lee filter reduces the speckle noise by applying a spatial filter to each pixel in an image, which filters the data based on local statistics calculated within a square window. The value of the center pixel is replaced by a value calculated using the neighboring pixels.(band 1 and band 2) are despeckled using three different window sizes and three different speckle noise variance levels estimated as multiples of the variance over the entire band.

- Use python for coding

- Data analysis-

•All the images are 75x75 images with two bands.

•Data fields- train.json, test.json-is presented in json (JavaScript Object Notation) format.

•The files consist of a list of images, and for each image, parameters like: id - the id of the image, band_1, band_2 - the flattened image data. Each band has 75x75 pixel values = 5625 elements; float numbers with unit being dB. Band 1 and Band 2 are signals characterized by radar backscatter, inc_angle - the incidence angle of which the image was taken. , is_iceberg - the target variable, set to 1 if it is an iceberg, and 0 if it is a ship. This field only exists in train.json.

•Test data - Machine-generated images excluded in scoring.

•Training data - field has missing data marked as "na", and those images with "na" incidence angles Train/Test is a method to measure the accuracy of your model.

It is called Train/Test because you split the the data set into two sets: a training set and a testing set. 80% for training, and 20% for testing.

- Data visualization- Scipy packages are used for visualization.

Annexure-IIA

Vidyalankar Polytechnic

# Department of Electronics and Telecommunication Engineering

**Name of Student: Sania Bandekar** **Enrollment No: 17201B0022**

**Name of Programme: Diploma in Digital Electronics/Electronics Engineering Program Group** **Semester: 5th**

**Course Title: Microwave and Radar** **Code: 22535**

**Title of the Micro Project:** Despeckling Synthetic Aperture Radar (SAR) Images

**Course Outcomes Achieved:**

## Micro Project Evaluation Sheet

| Process Assessment | | Product Assessment | | Total |
|---|---|---|---|---|
| **Part-A** **Project Proposal (Mark-2)** | **Project** **Methodology (Mark-2)** | **Part-B** **Project Report/ Working Model (Marks-2)** | **Individual** **Presentation/ Viva (Marks-4)** | **Marks 10** |
| | | | | |

**Note: Every course teacher is expected to assign marks for group evolution in first 3 columns and individual in 4th columns for each group of students as per rubrics.**

**Comments/Suggestions about team work/leadership/inter-personal communication (if any)**

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**Any other Comments:**

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**Name and Designation of Faculty Members**

**Signature:**