2023

Inter IIT Tech Meet 11.0

ISRO CHANDRAYAN MOON MAPPING CHALLENGE

Presentation by
Team 53

Problem Statement

Development of an AI/ML model to generate a **HIGH RESOLUTION LUNAR TERRAIN IMAGE(~30 cm)** from medium/low (5 m / 10 m) resolution terrain image and to generate a **GLOBAL LUNAR ATLAS** using the data obtained from the model.

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DATA GENERATION AND PRE-PROCESSING

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SCRAPING

DOWNLOAD OHRC DATASET

We download the OHRC dataset and use this data set for training and inference

TMC-OHRC OVERLAP

We systematically search the TMC data base for images that overlap with OHRC images using selenium, based on the coordinates of the OHRC Image

NAC

We use the NAC database as an alternative to get high-low resolution image pair for visual comparision of the atlas.

PRE-PROCESSING

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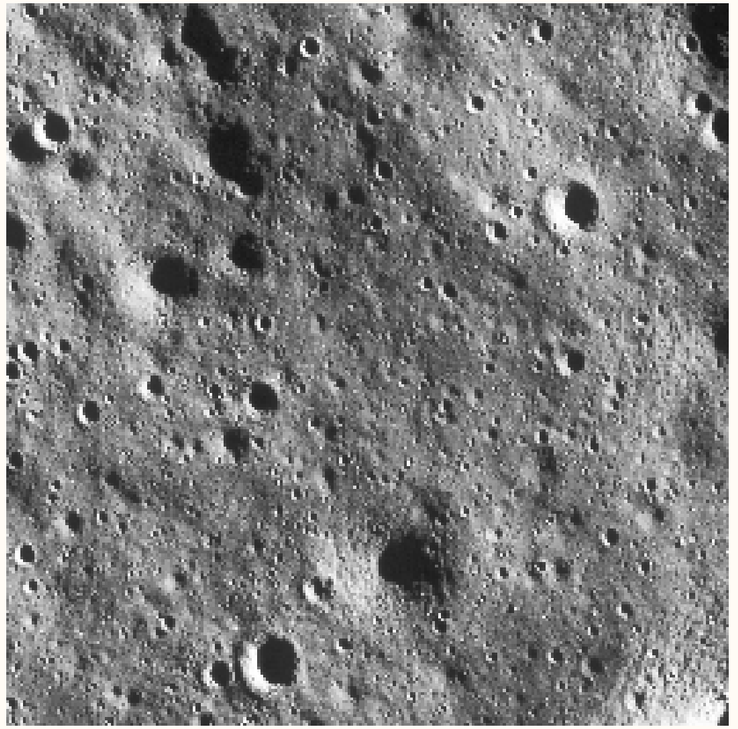
Full Size OHRC Image
~1,20,000 x 12,000
pixels



256 x 256 Pixel Section

PRE-PROCESSING

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- Remove dark patches and sections with no data.
- Remove images with

$$\sum_{i,j} \text{Image}[i,j] < 2\% \text{ of maximum intensity}$$

- Convert the images to 3-Channel using open CV.
- Down-sample the 256x256 images to 16x16 using bi-cubic interpolation for testing the model.

PRE-PROCESSING

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- ~6,00,000 images(256x256 pixels) for training after removing dark patches.
- We sample 20,000 images based on uniform distribution to train our network.
- Test Set containing 400 images to evaluate the model

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EDSR	SWINIR	SWIN-LTE	SR3
~1 MILLION	~15 MILLION	~15 MILLION	~1 BILLION

LITERATURE SURVEY

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WHY SWINIR-LTE

SOTA

SWINIR delivers state of the art perfomance on several benchmarks.

Arbitrary Scaling

Local Texture Estimator(LTE) allows arbitrary scaling factors to be used.

Medium Model Size

Model size is considerably less than Diffusion based models.
Hhowever the model is complex enough to learn from large dataset

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WHY SWINIR-LTE

Image Super-Resolution	Set14 - 4x upscaling	SwinIR	PSNR	29.15	# 4
			SSIM	0.7958	# 8
Image Super-Resolution	Set5 - 4x upscaling	SwinIR	PSNR	32.93	# 4
			SSIM	0.9043	# 6
Image Super-Resolution	Urban100 - 4x upscaling	SwinIR	PSNR	27.45	# 4
			SSIM	0.8254	# 5

SWINIR Reported Metrics

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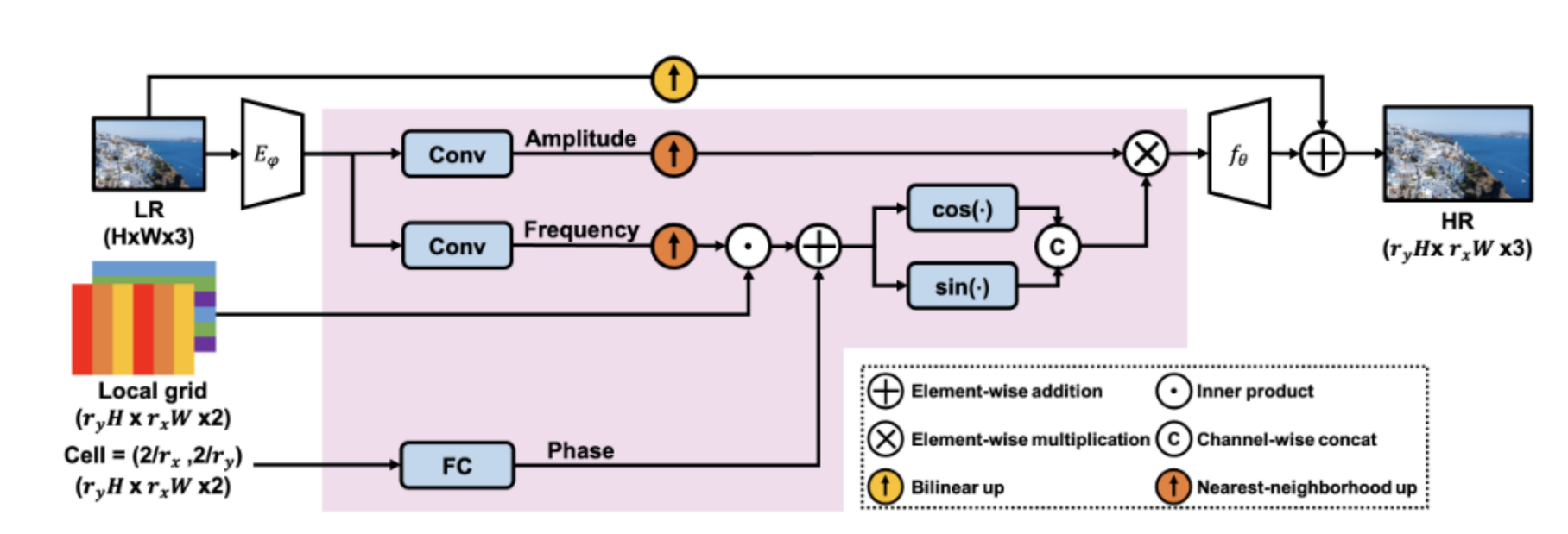
Architecture



RESULTS

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METRICS FOR SWINIR-LTE

METRIC	VALUE
PSNR	49.162236700
FSIM	0.42840393111
SSIM	0.97565720236

RESULTS

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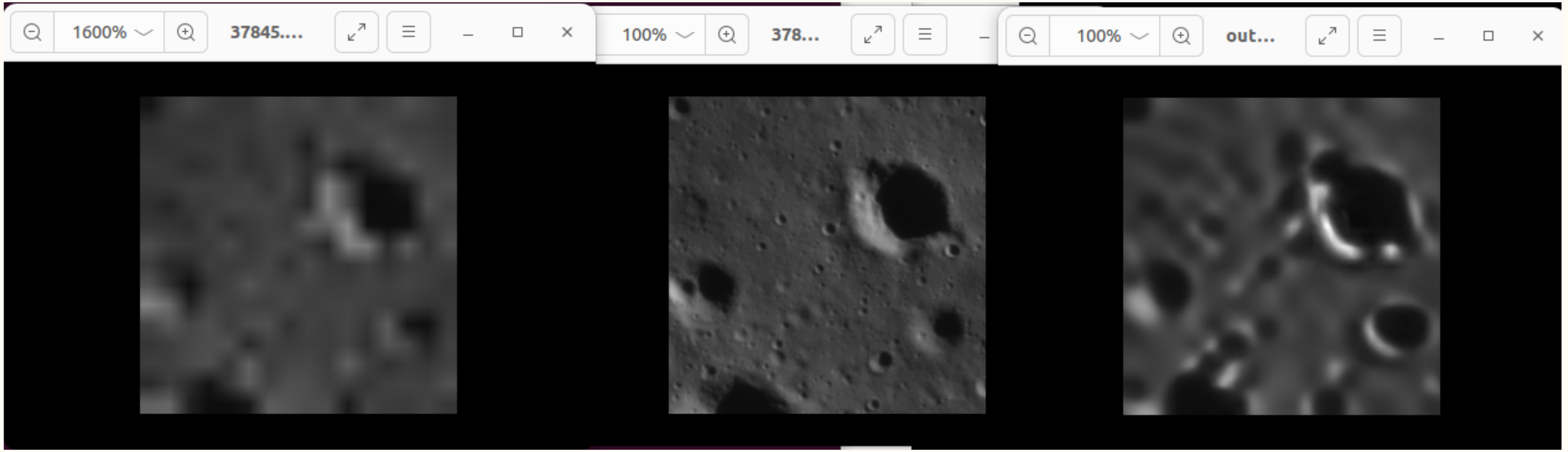

Visual Comparison: (*From left, clockwise*) 16x16 pixel downsampled image, high resolution ground truth, Prediction from model.

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Atlas Generation

We have to generate global lunar atlas of 1 degree x 1 degree from Upscaled images generated from our model

Our Approach

Intial Grid

We first defined a region of 1 degree X 1 degree of latitude and longitude

Upsacled Images

We find latitude and longitude of upscaled images generated by our model and we paste images on the correct location of the grid

Overlapping Images

As of now, we have taken any pixel at a particular latitude and longitude but we can also take median value of pixels

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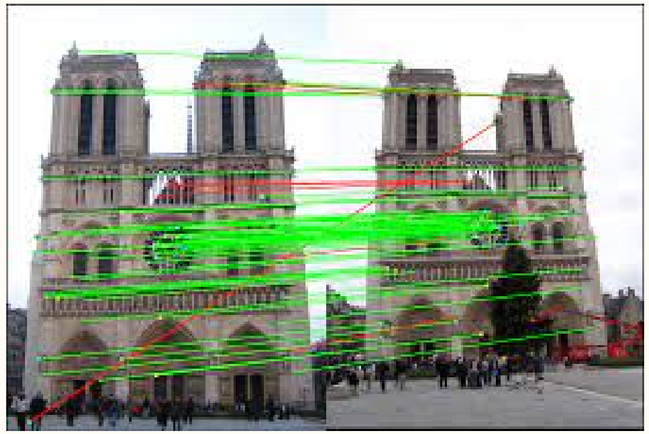
Other Approaches

IMAGE MATCHING



HOMOGRAPHY MATRIX

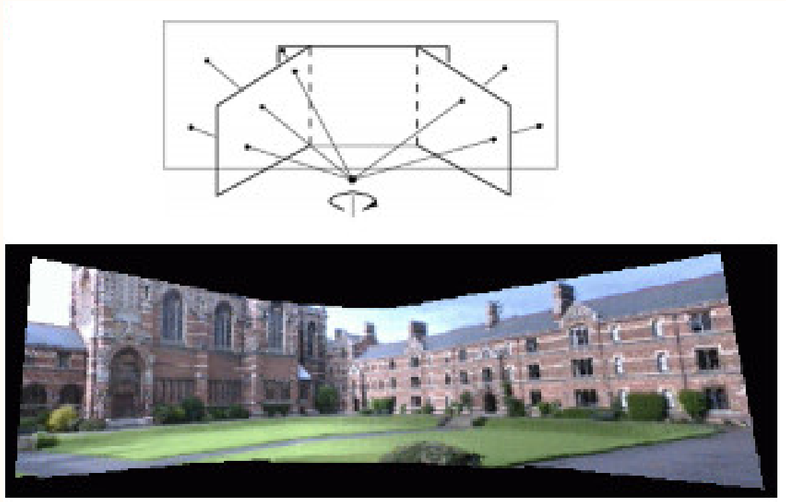
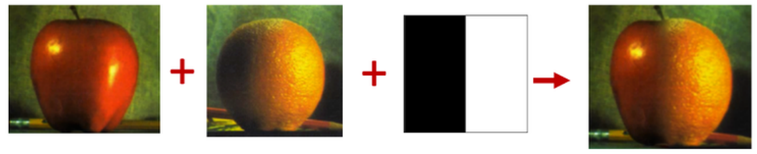


IMAGE BLENDING



ATLAS

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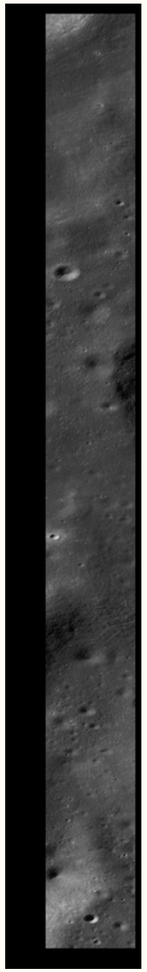
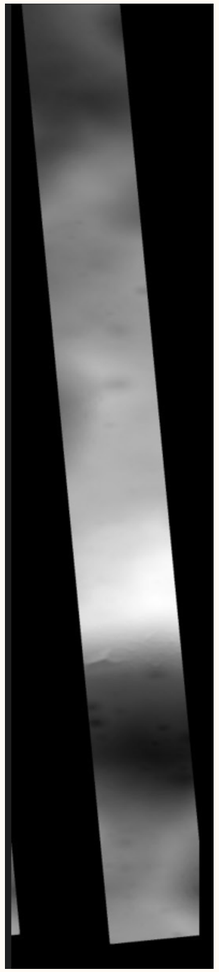
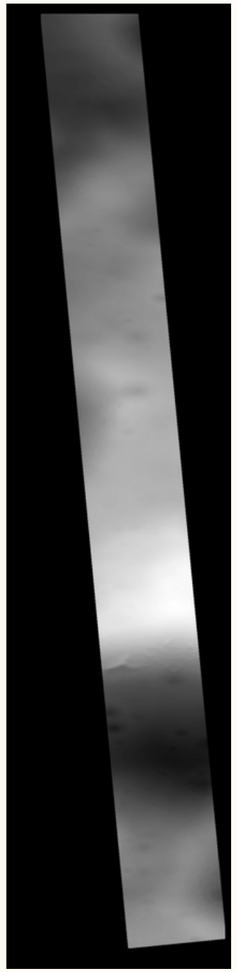


NAC Image
(Comparable to Upscaled TMC in resolution)



Upscaled TMC
46080x9120



Original TMC
(2882x570)

UL=273.4,-55.91
UR=273.5,-55.91
LL=273.59,-56.86
LR=273.49,-56.87

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THANK YOU