

Windows on Earth

Hemant Kumar Singh
Jaisal Singh
Vedika Srivastava

About the Project

🚀 **Client:** TERC is an organization primarily focused on research and development in K-12 STEM education. They are executing a project under the Windows on Earth program, which primarily deals with astronaut photographs received from the International Space Station (ISS).

🚀 **Problem :** The Windows on Earth program receives images from the ISS with known ISS locations but without specific details about what each photo depicts. Generally, the subject of each image is within a 300-mile radius of the ISS location. The challenge lies in accurately predicting or geolocating the specific subject area or landmark presented in each image.

🚀 **Desired Outcomes and Expected Deliverables:** The aim is to develop a prototype utilizing image recognition and ML in combination with a virtual world simulator, like Cesium, to automatically geo-locate the images. The expected deliverables also include a set of recommendations for further improvement and development of the project.

TERC

Because math and science build futures

CLIENT

David Libby

Chief Tech Officer, TERC

Dataset Overview and Initial Analysis

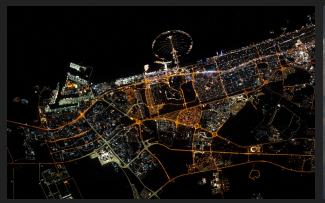
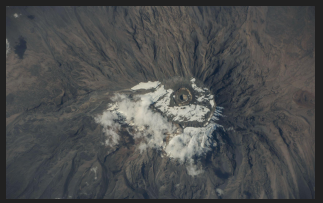
🚀 **Dataset:** The dataset comprises of 143 images captured by ISS satellites. Each image is enriched with EXIF and GPS metadata, revealing vital details like the ISS location, camera parameters and data & time each photo was captured.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	ImageFiler	GPSVersio	GPSLatituc	GPSLatituc	GPSLongit	GPSLongit	GPSAltitud	GPSSpeed	Resolution	ExifOffset	ImageDesc	Make	Model	Software	DateTime	Copyright	XResolutic	YResolutic	ExifVersio	ShutterSpe	ApertureV	DateTime(	DateTime(
2	iss036e04		S	(2.0, 34.36	E	(36.0, 25.5	412491.11	27598.746	2	340	35S Part 2	NIKON CO	NIKON D3	Adobe Phc	2020:03:3	ÃfÂÃƒÂŠÃf	240	240	0231	9.643856	6.33985	2013:06:1	2013:06:1
3	iss038e06		N	(42.0, 10.5	E	(14.0, 55.1	417359.41	27597.964	2	438	MysteryIm	NIKON CO	NIKON D3	Adobe Phc	2020:05:06	11:49:33	240	240	0231	9.965784	5.310704	2014:03:0	2014:03:0
4	iss040e06		S	(22.0, 22.0	E	(26.0, 17.4	420041.27	27578.846	2	620	Caption by	NIKON CO	NIKON D3	Adobe Phc	2021:02:2	945_7039.	240	240	0231	12.64386	4.643856	2014:07:1	2014:07:1
5	iss040e07		N	(32.0, 8.85	W	(110.0, 6.7	421514.9	27579.205	2	266		NIKON CO	NIKON D3	Adobe Phc	2022:07:2	945_7039.	240	240	0231	11.96578	2.970854	2014:07:2	2014:07:2
6	iss040e09		N	(38.0, 42.6	E	(15.0, 20.8	414689.11	27608.750	2	256		NIKON CO	NIKON D3	Adobe Phc	2017:10:1	945_7039.	240	240	0230	11.64386	2.970854	2014:08:1	2014:08:1
7	iss040e12		N	(51.0, 36.7	E	(3.0, 38.93	419584.22	27602.119	2	232		NIKON CO	NIKON D2	Adobe Phc	2017:10:16	12:48:31	240	240	0230	11.64386	4.970854	2014:09:0	2014:09:0

	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT
1	ExposureB	MaxAperti	MeteringM	LightSourc	Flash	FocalLengt	ColorSpac	WhiteBala	DigitalZoo	FocalLengt	SceneCapt	OffsetTim	SubsecTim	Saturation	Sharpness	SubjectDis	SensingMe	FileSource	ExposureT	FNumber	SceneType	ExposureP	CustomRe
2	0	6	5	0	0	1200	1	0	1	1200	0	-04:00	71	0	0	0	2		0.00125	9		1	0
3	0	5	5	0	0	800	1	0	1	800	0	-04:00	24	0	0	0	2		0.001	6.3		1	0
4	-1	3	5	0	0	200	1	0	1	200	0	-05:00	95	0	0	0	2		0.000156	5		1	0
5	0	3	5	0	0	200	1	0	1	200	0	-04:00	08	0	0	0	2		0.00025	2.8		1	0
6	0	3	3	0	0	80	1	0	1	80	0		65	0	0	0	2		0.000313	2.8		1	0
7	-2	5	5	0	0	800	1	0	1	1200	0		16	0	0	0	2		0.000313	5.6		3	0

	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ
1	ISOSpeedF	ExposureM	BodySerial	LensSpecif	LensMode	GainContr	Contrast	CFAPatter	UserComm	Orientatio	ExifImageV	ExifImageH	FocalPlane	FocalPlaneYResolu	FocalPlane	Sensitivity
2	200	1	5033554	(600.0, 60	600.0 mm	0	0									
3	200	1	2053892	(400.0, 40	400.0 mm	0	0									
4	200	1	2007945	(80.0, 200.	80.0-200.0	0	0		ASCIINASA#2007945							
5	200	1	2007945	(80.0, 200.	80.0-200.0	0	0		ASCIINASA#2007945							
6	200	1	2007945	(80.0, 200.	80.0-200.0	0	0		ASCIINASA#2007945							
7	200	0	6027268	(800.0, 80	800.0 mm	0	1		ASCIINASA S/N 1142		77.0F					
8	200	0	2008337	(80.0, 200.	80.0-200.0	0	0		ASCIINASA	1	4256	2832				
9	200	1	2071131	(70.0, 200.	70.0-200.0	0	0		ASCIINASA 2071131		75.2F		1368.8888	1368.8888854980	3	2
10	200	0	2071129	(50.0, 500.	50.0-500.0	0	0		ASCIINASA 2071129		78.8F		1368.8888	1368.8888854980	3	2



Dataset Overview and Initial Analysis

Research Survey

🚀 **Suitable ML Methods:**

- Template matching - SFIT or SEC2-LoFTR
- Key point detection and extraction
- Cloud cover segmentation

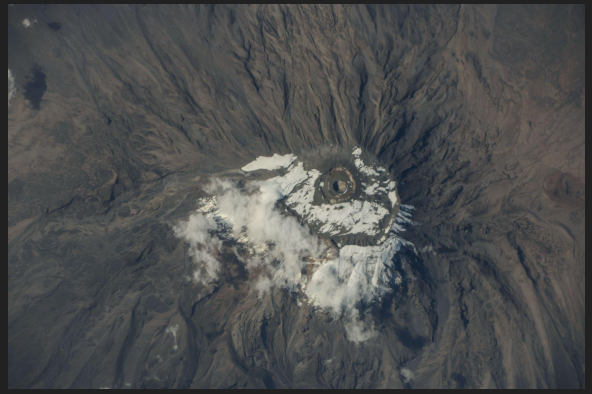
🚀 **Relevant Papers/Models:**

- Find My Astronaut Photo
- Fine-Grained Cross-View Geo-Localization
- Image-to-GPS Verification Through A Bottom-Up Pattern Matching Network
- Automatic Georeferencing of High-Resolution Nighttime Light Imagery

🚀 **Useful Repos:**

- Area of Interest: Cesiumpy , Mapwidget. Satellite-imagery-downloader
- Image matcher: SE2-LoFTR

Approach and Deliverables



Sample Image from the dataset

ISS location w.r.t. the sample image

Google Earth simulation of the image

🚀 **Mode of Delivery:** Prototype model for for future integration and enhancement on client website.

Thank You!

Any questions??