Clean Space

CNN4NEOOD

CONVOLUTIONAL NEURAL NETWORK FOR NEAR EARTH OBJECT OBSERVATION AND DETECTION

URBYet ORBIT

Geospatial Company

Rome, Genova

Mauro Venanzi
Telecommunication Engineer
MBA MIP/Prince2®

TR2 In Motion Insight

Visual Analytics Company

Rome, Aosta, Cagliari, Tenna (Tn)

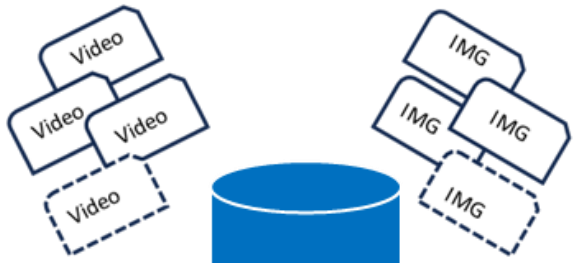
Aiswarya Unni
Space and Astronautical Engineering
AI Software Engineer

Purpose

Simulating the Space Environment dynamics obtaining a 3D virtual scenario from imagery and applying A.I to create an **Agent based on Deep Reinforcement Learning** to map the Environment Transitions in order to develop a solution **for space debris tracking.**

Mauro Venanzi – Aiswarya Unni

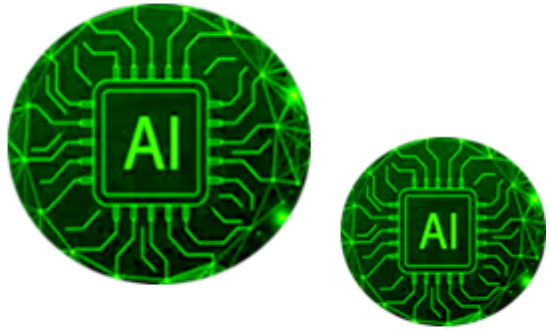
Concept



Stereo Photoclinometry
Stereo Photogrammetry

In-Lab 3D

Generative/Cognitive



Agent

DRL –Deep Reinforcement learning

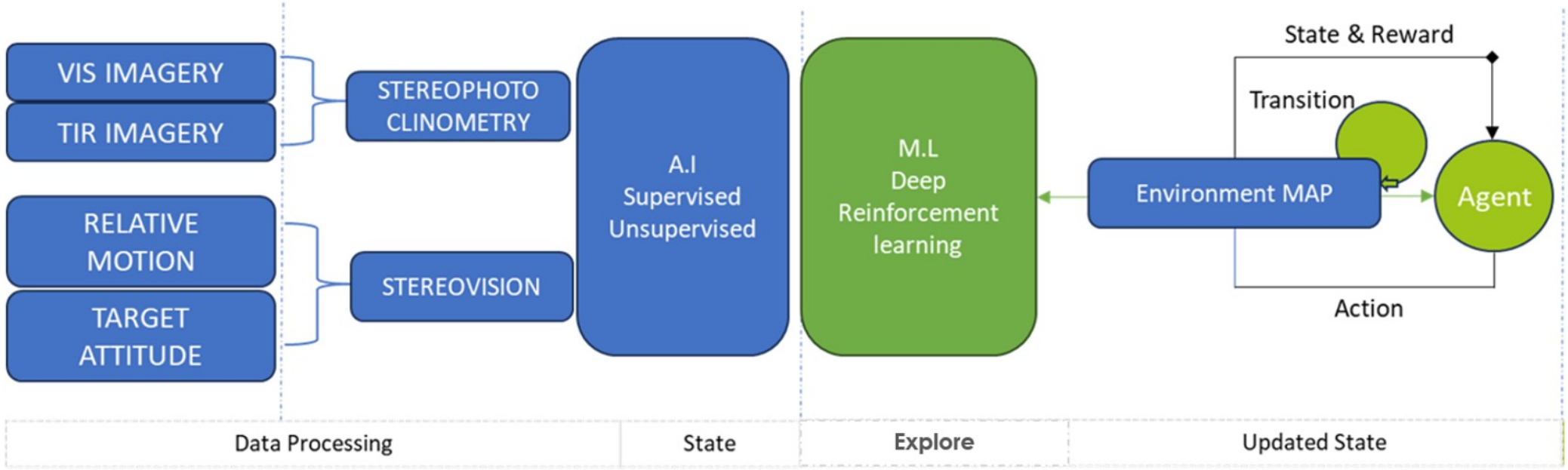
Uncertainties Mitigation

- Light
- Distance
- Speed
- Bandwidth
- New Acquisition

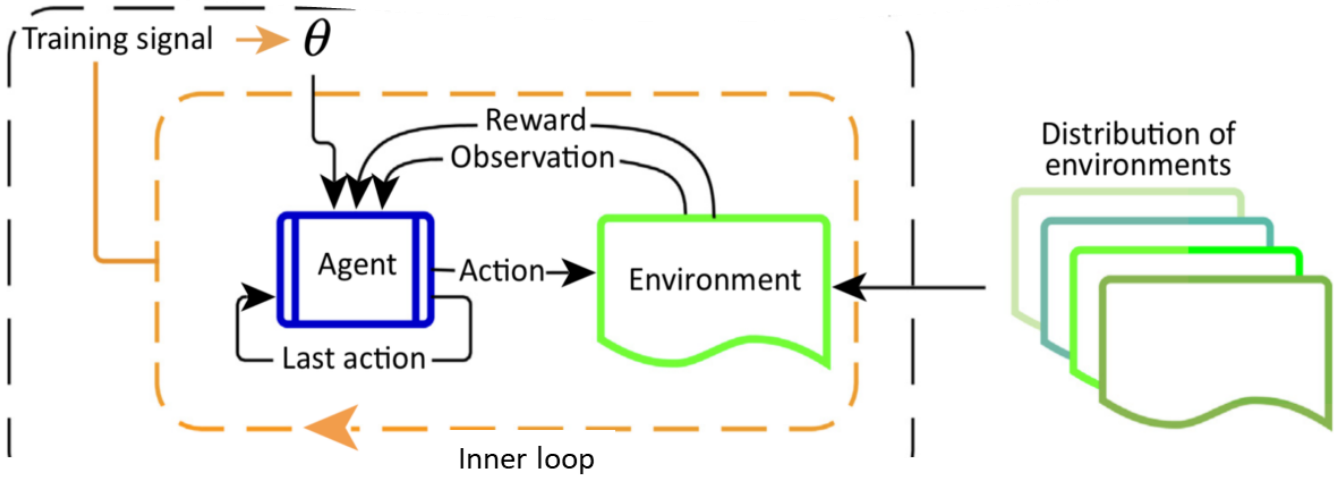
Partially Observable Markov Decision Process (POMDP)

Debris Tracking

Design


VIS IMAGERY
TIR IMAGERY
RELATIVE MOTION
TARGET ATTITUDE
STEREOPHOTO CLINOMETRY
STEREOVISION
A.I
Supervised
Unsupervised
M.L
Deep
Reinforcement
learning
State & Reward
Transition
Environment MAP
Agent
Action
Data Processing
State
Explore
Updated State

Meta Reinforcement Learning



Agent for unseen scenarios | **Meta-RL to** leverages experiences

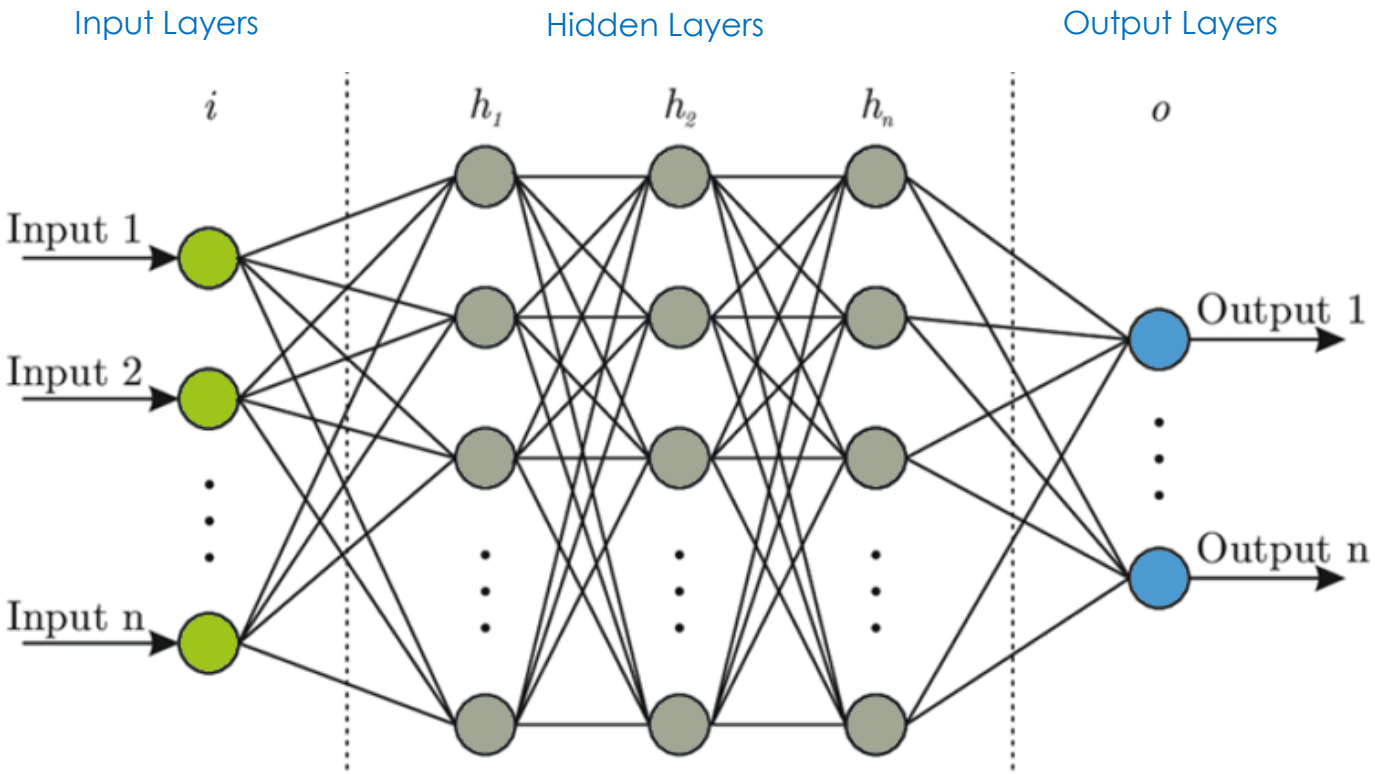
State Action Tuple

State (S):
- Represents Agent's observations both present and history of past observations
- Includes positions and velocities of space debris, sensor data and state of the Agent

Action (A):
- Represents the agent's decision
- Increase the detection accuracy by increasing the map score

Reward (R):
- Can be positive (reward +1) or negative (reward -1) according to the Map percentage in each time steps.

Multilayer Perceptron Dimensioning



Number, size of hidden layers
VS
Network capability to learn

Learning Rate
VS
Network Stability

Simulation Constraints

Magnitude of relative distance between two bodies should not be less than the threshold value.

$$|d| \geq D_{threshold}$$

Process and analysis of each reconstructed 3D frame for incoming Debris should be within the time limit.

$$map_{score} >= map_{threshold}$$

Simulation

RL Agent successfully track the Debris, with high map_{score}.

RL Agent fails to track debris

Simulation constraints are violated

On the episode time-out

Termination

Roadmap

M1-M4	M5-M7	M8-M24			M25-M26
Startup	Initializing	Production			Closure
Outlined Proposal	Proposal	CDR	AI development		
Agreements	Business Plan	FAT	Data processing		
Partnerships	Partners	SAT	State definition	Testing	Formalities
Teaming	Team	Lab setup	DLR Development	Fine tuning	
BDR	Procurement	Datasets	State transition	Delivery	
	Outlined CDR		Environment Map		

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Thank you !