



UNIVERSITÀ DI PISA



Consiglio Nazionale
delle Ricerche

+

•

○

MARITIME TRAFFIC MONITORING USING DEEP LEARNING

Ch Muhammad Awais

chmuhammad.awais@phd.unipi.it



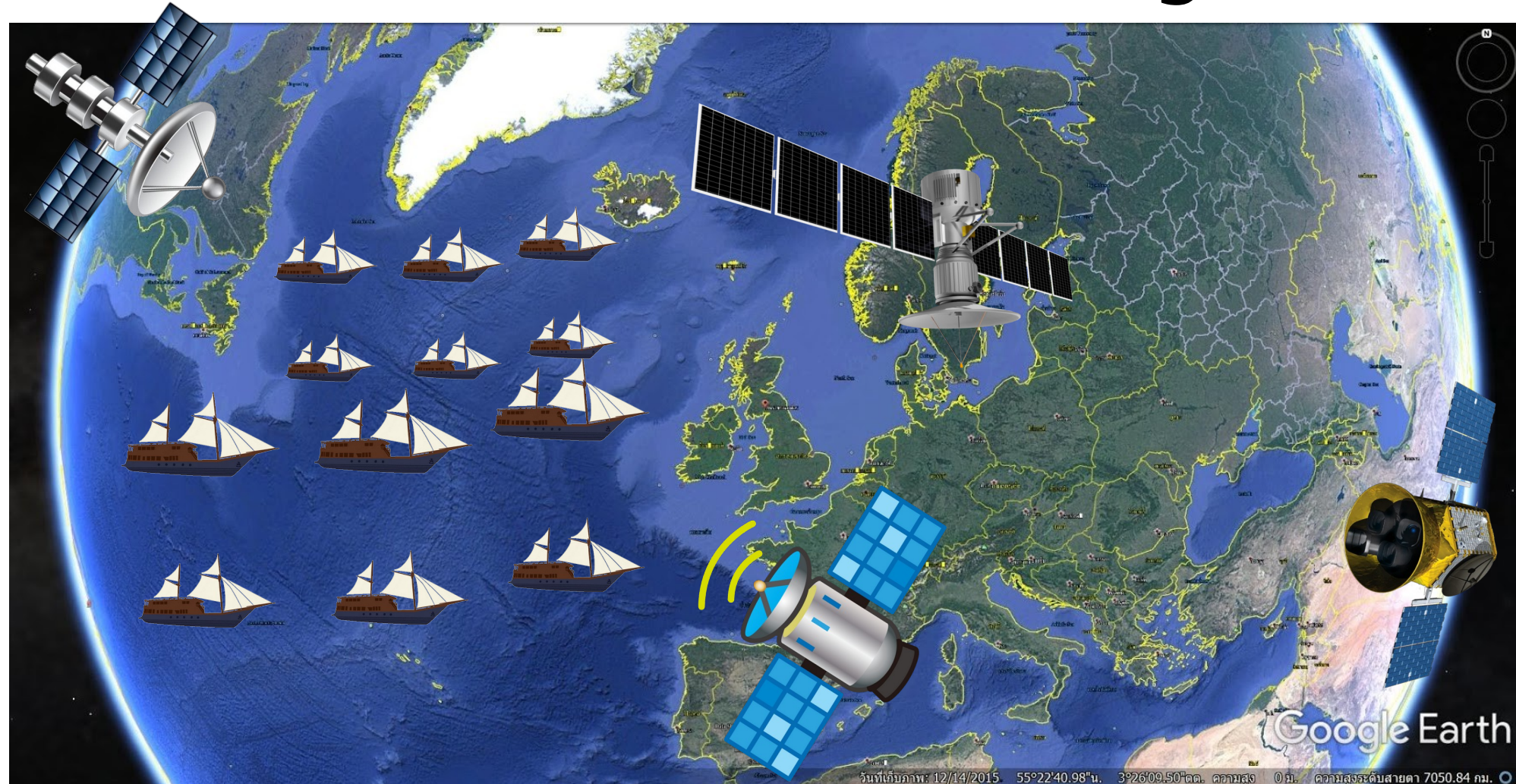
**WHO
CARES?**

© & TM WBEI. (s20)

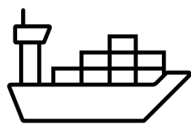
Table of Contents

- Maritime Traffic Monitoring
 - Data
 - Limitations
- Proposed Solutions

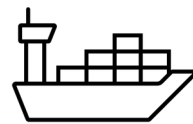
Maritime Traffic Monitoring



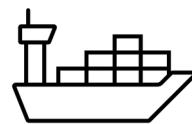
Motivatio



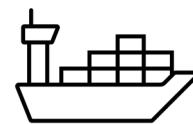
SAR



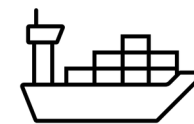
AIS



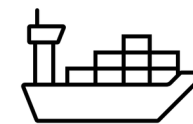
Ship-



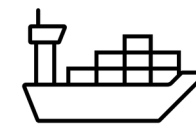
Limitation



Solutions



D-

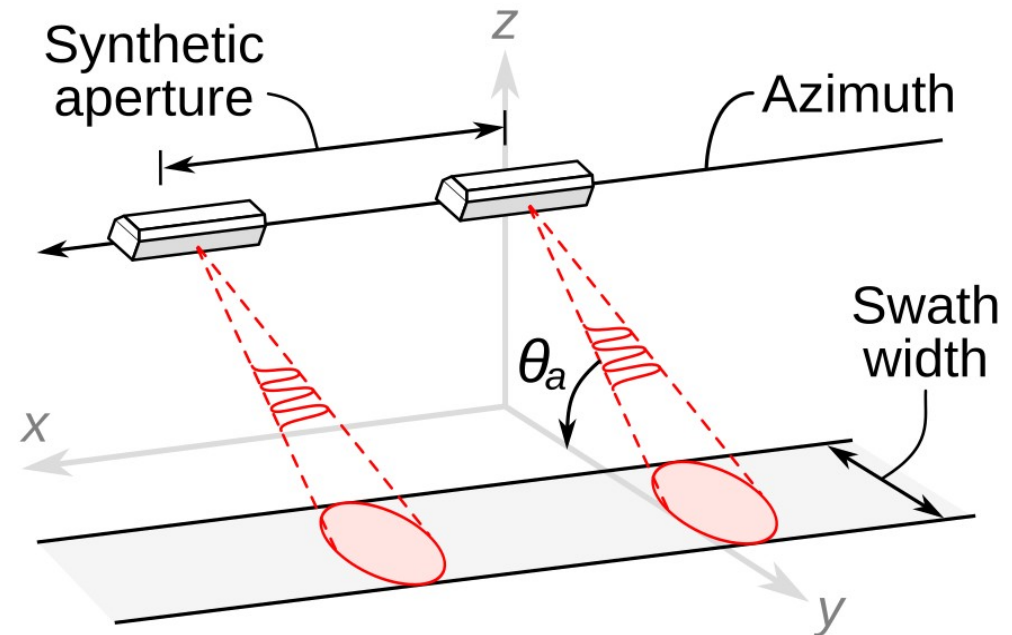


SResoluti

Synthetic Aperture Radar

- High Resolution.
- Weather and Light Conditions.
- Repeatedly captures.

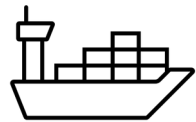
Synthetic aperture radar



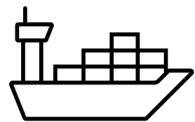
Motivatio



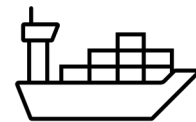
SAR



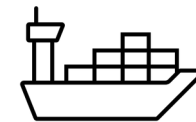
AIS



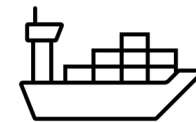
Ship-



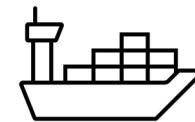
Limitation



Solutions

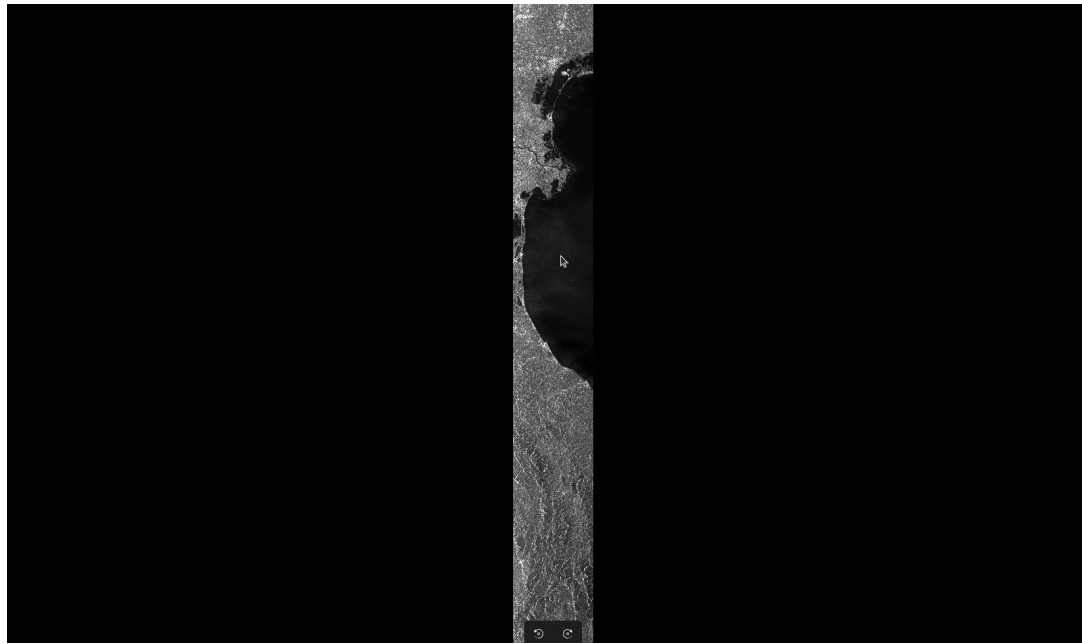


D-

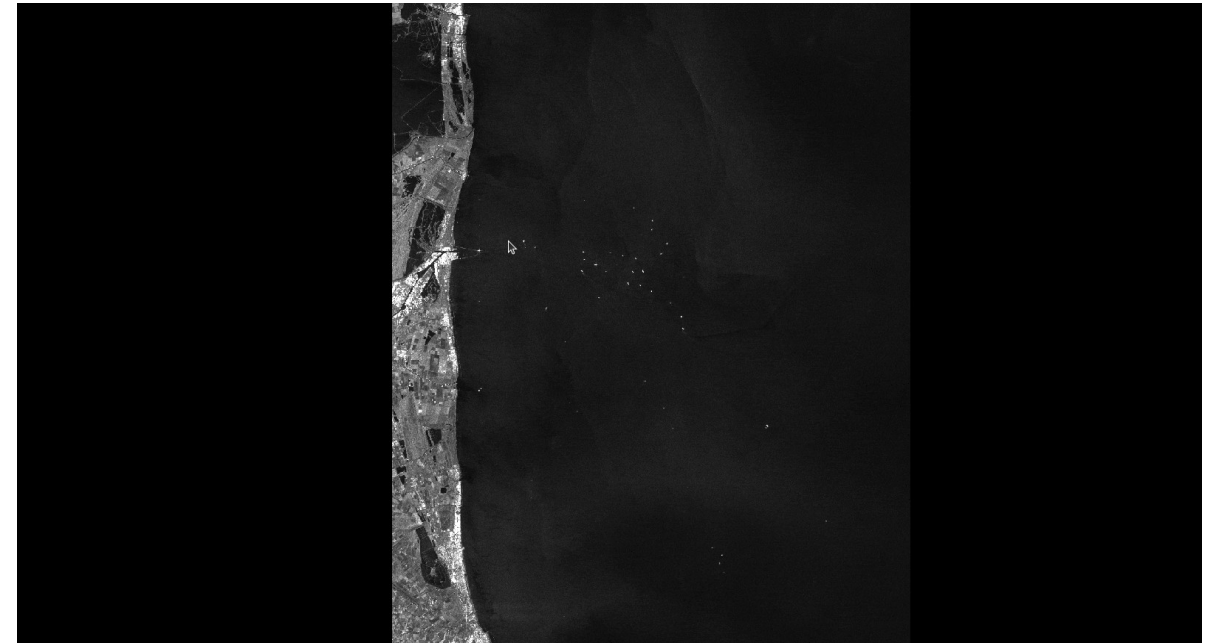


SResoluti

SAR images (Limitations)



Low Vessel resolution in SAR Images



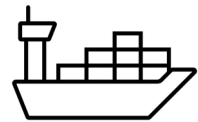
Interesting Wake patterns in SAR Images



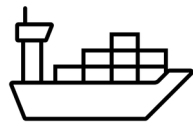
Motivatio



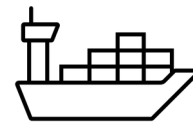
SAR



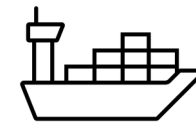
AIS



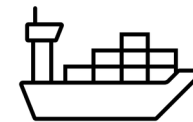
Ship-



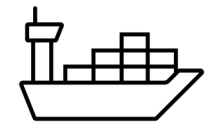
Limitation



Solutions



D-



SResoluti

Automatic Identification System

- Real Time Tracking.
- Collision Avoidance.
- Identification

Limitations:

- Not always available

Field Name	Data Type	Description
timestamp	String	ISO 8601 formatted timestamp in UTC of the AIS message transmission
latitude	Float	Vessel Latitude
longitude	Float	Vessel Longitude
speed	Float	Vessel speed over ground in Knots
course	Float	Vessel course over ground in degrees
heading	Float	Degrees at which the vessel is heading
rot	Float	Rate at which the vessel is turning
eta	String	Estimated time of arrival of the vessel
status	String	Navigation status of the vessel

AIS Dynamic Data



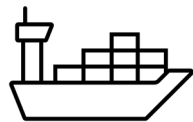
Motivatio



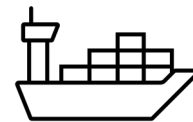
SAR



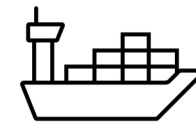
AIS



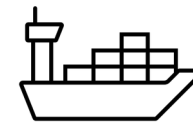
Ship-



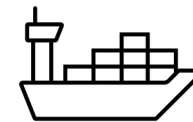
Limitation



Solutions

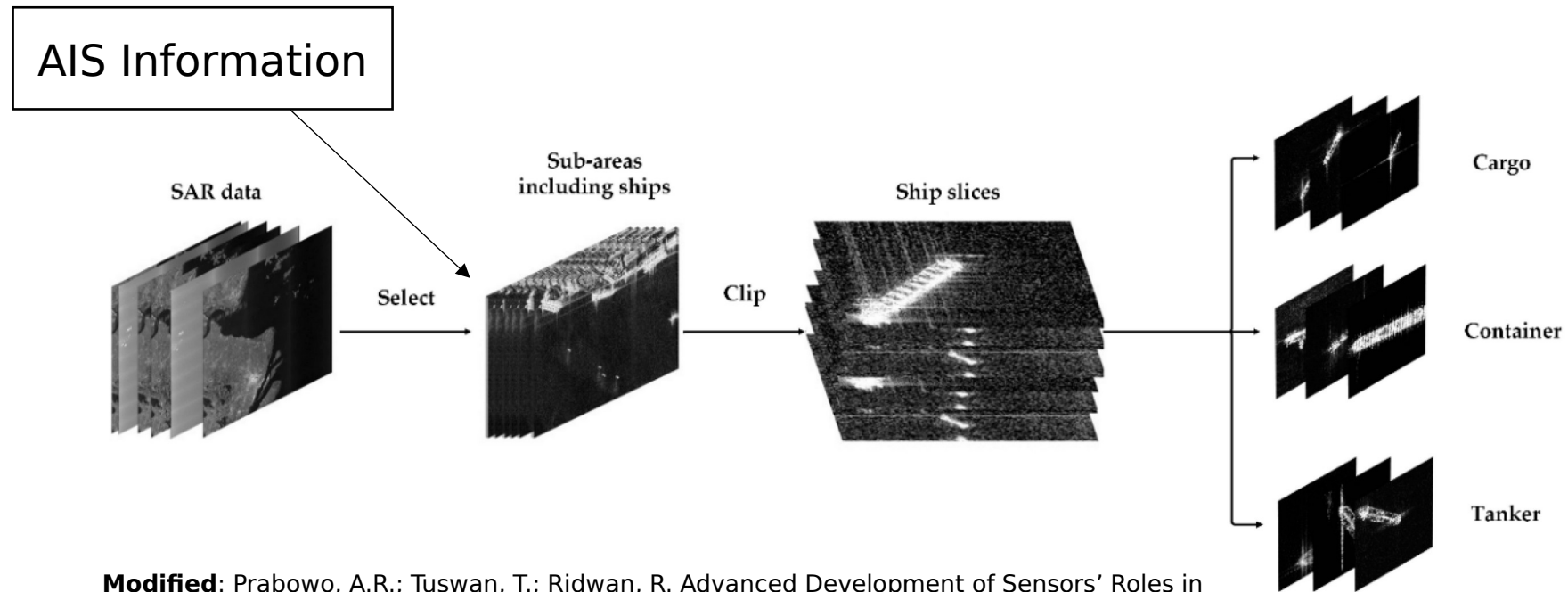


D-



SResoluti

Ship Classification



Modified: Prabowo, A.R.; Tuswan, T.; Ridwan, R. Advanced Development of Sensors' Roles in Maritime-Based Industry and Research: From Field Monitoring to High-Risk Phenomenon Measurement. Appl. Sci. **2021**, *11*, 3954.

Public Dataset: FUSAR-Ship & OpenSARShip



Motivatio



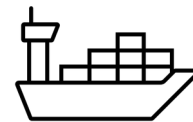
SAR



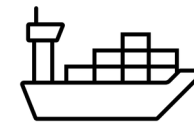
AIS



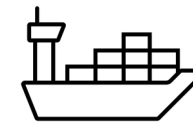
Ship-



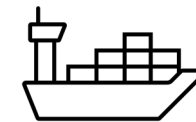
Limitation



Solutions



D-



SResoluti

Limitations?

- Data Scarcity
 - Only two public datasets
 - No Pipelines for Dataset creation
- Model Selection
 - No task specific models
- Object resolution
 - Low resolution of vessels



Motivatio



SAR



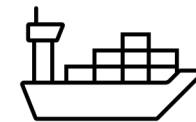
AIS



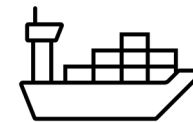
Ship-



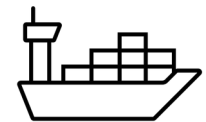
Limitation



Solutions



D-Learning



SResolutio

Proposed Solution

- Dataset analysis
- Image processing analysis
- Task-specific models



Motivatio



SAR



AIS



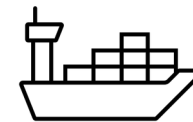
Ship-



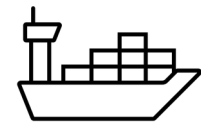
Limitation



Solutions



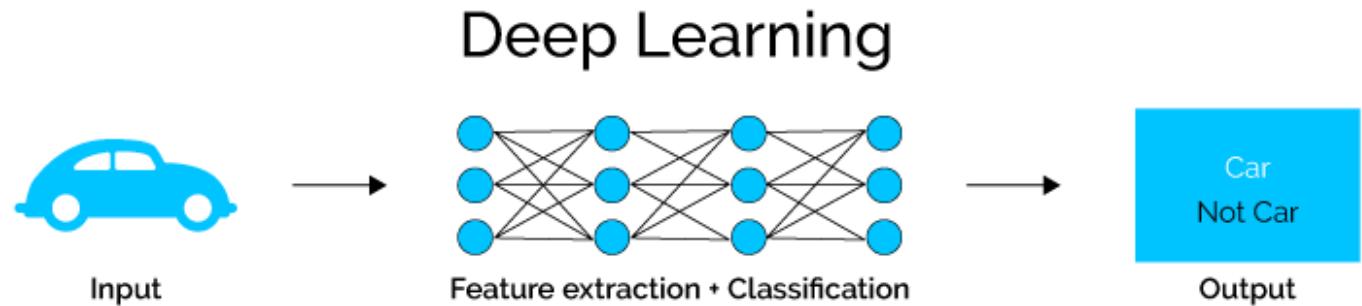
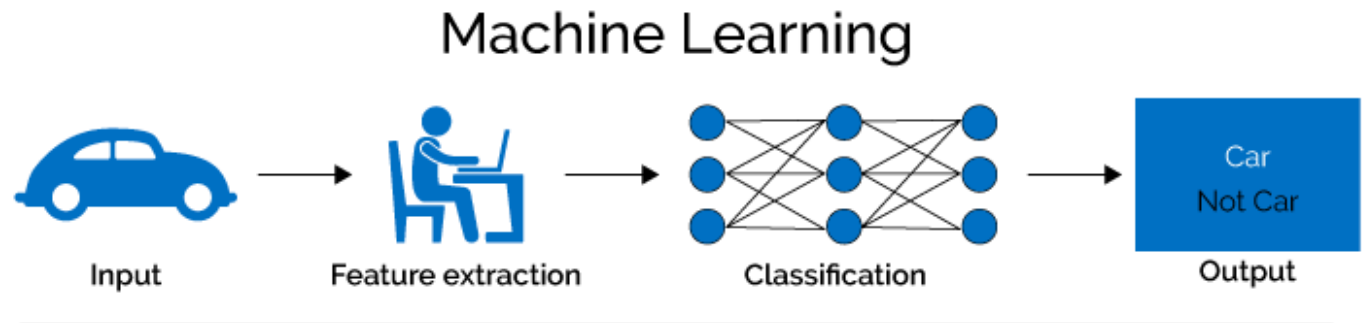
D-



SResoluti

Deep Learning

- Model Architecture
- Hyper-parameters
- Loss Function
- Pre-Processing



Motivatio



SAR



AIS



Ship-



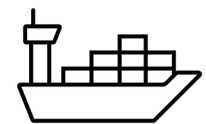
Limitation



Solutions



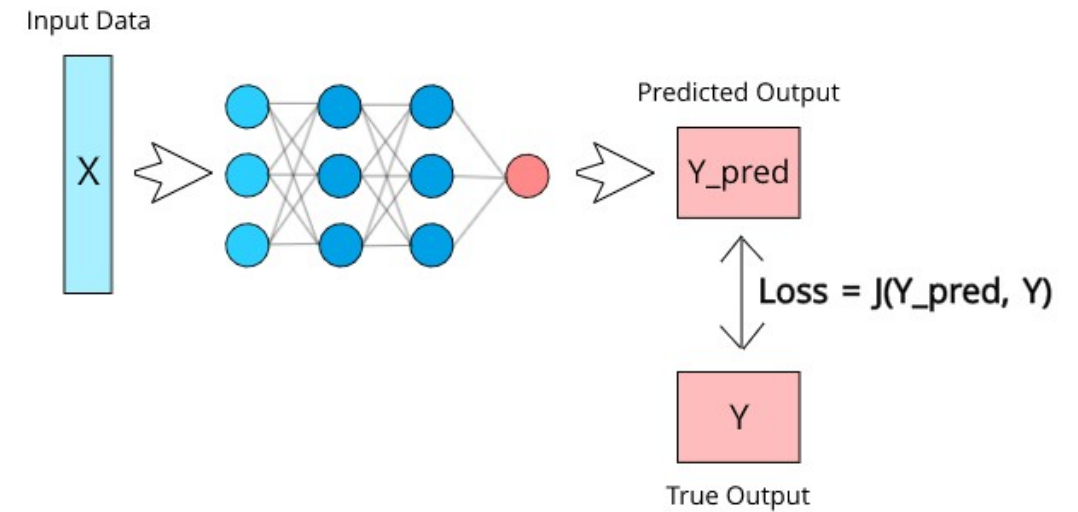
D-



SResoluti

Loss Functions

1. Quantifies error
2. Guides training
3. Evaluates performance



Motivatio



SAR



AIS



Ship-



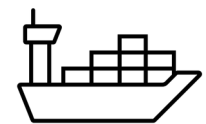
Limitation



Solutions

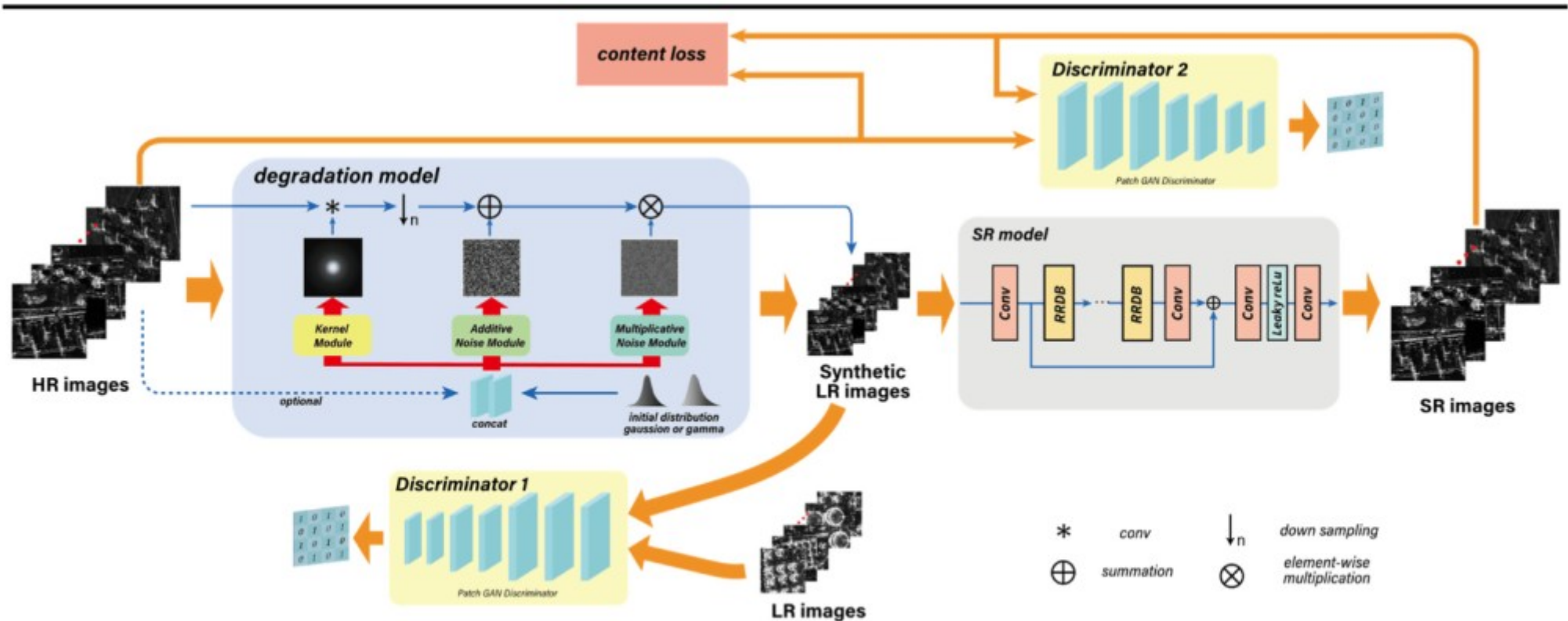


D-



SResoluti

Super Resolution



Zhang, C.; Zhang, Z.; Deng, Y.; Zhang, Y.; Chong, M.; Tan, Y.; Liu, P. Blind Super-Resolution for SAR Images with Speckle Noise Based on Deep Learning Probabilistic Degradation Model and SAR Priors. Remote Sens. **2023**, *15*, 330.



Motivatio



SAR



AIS



Ship-



Limitation



Solutions



D-



SResolutio

QUESTIONS AND ANSWERS

