# Ship-GAN: Generative Modeling Based Maritime Traffic Simulator

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Introduction

We develop a system using electronic navigation charts to generate realistic and high-fidelity vessel traffic data using Generative Adversarial Networks (GANs).

- Our proposed Ship-GAN uses a conditional Wasserstein GAN to model a vessel's behavior.
- The generator can simulate the travel time of vessels across different maritime zones conditioned on vessels' speeds and traffic intensity.

Maritime Traffic Domain
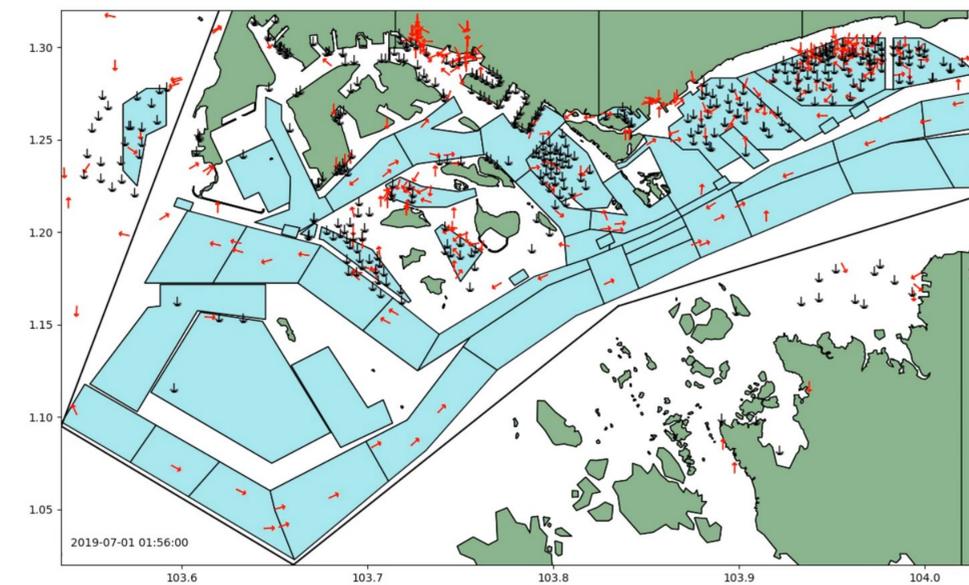
Electronic navigation chart of Singapore with ship Positions. The strait has been split into zones.

Motivation:

- The Straits of Malacca and Singapore provides the shortest route between Indian Ocean and South China Sea.
- Popular for oil tankers & cargos traveling through the strait.
- Complex traffic activities near port water.
- Vessel runs on a schedules, with constraints on the delay.

Maritime Data

- We train our model 2.5 million maritime vessel records of real historical data obtained from a private maritime data provider.
- The vessel data spans 1 month and contains all the ship location(and other status) update in the Singapore strait.
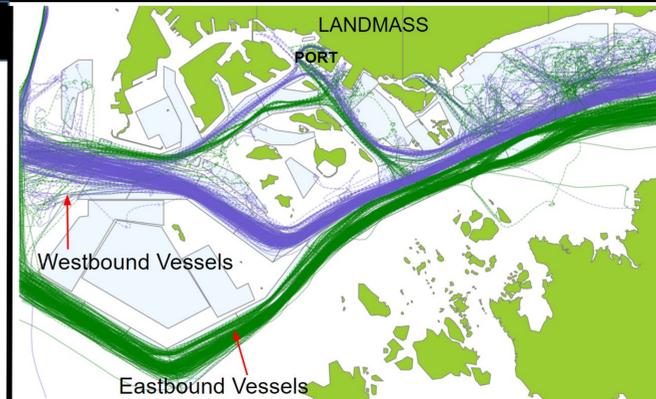
Vessel routes overlayed on Singapore Strait. There are more than 50,000 vessel movements/year, which corresponds to 200-300 passages/day

Generative modeling of travel time

Challenges :

- Vessels unlike cars can never stop.
- Uncertainty in travel time durations.
- The uncertainty is due to weather conditions, tide etc.

Architecture :

$$\tau_f \in (-1, 1)$$
$$\tau_r \in (-1, 1)$$
$$\epsilon \sim \mathcal{N}(0, 1)^{16}$$
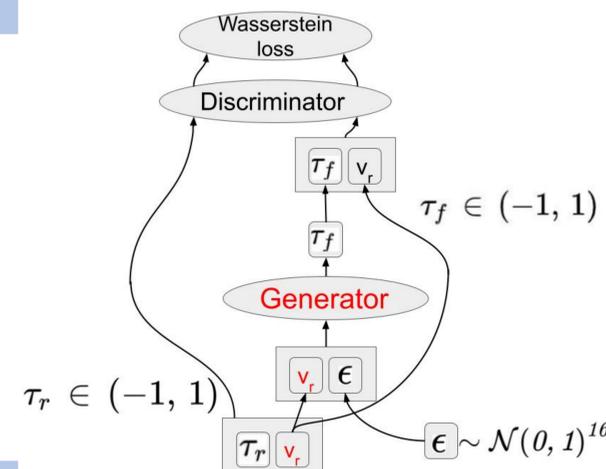
Contribution:

- We develop a deep generative model-based simulation of key aspects of ship traffic.
- Based on statistical measure such as KS distance, our approach achieves better solution quality than baselines.

Experiments

Predicted travel distances for a zone(14).
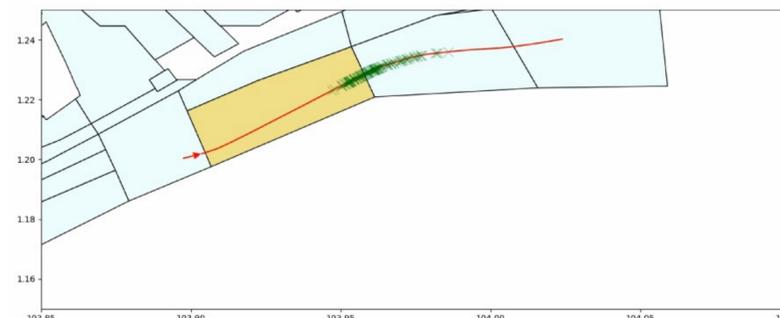
Quantitative Results:
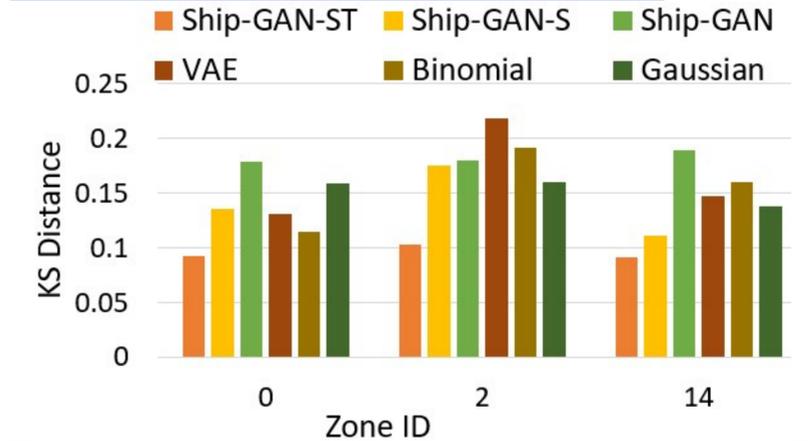
Conditional Generative model training snapshot:
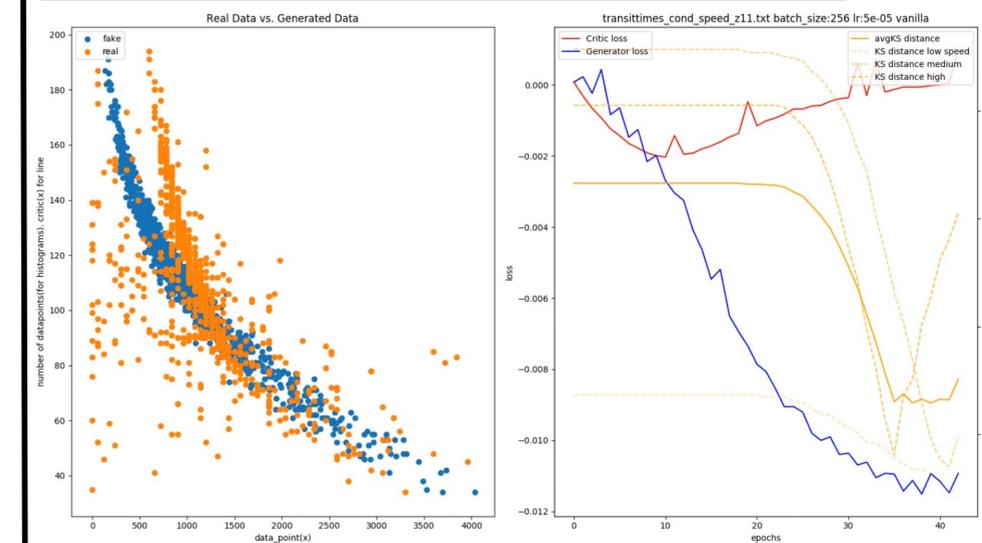
Unconditional GAN results:

Acknowledgement