LOGI AI RESEARCH INSTITUTE

VESSEL TRACKING ENGINE

An explainable framework for estimated positions, registered routes and ETA

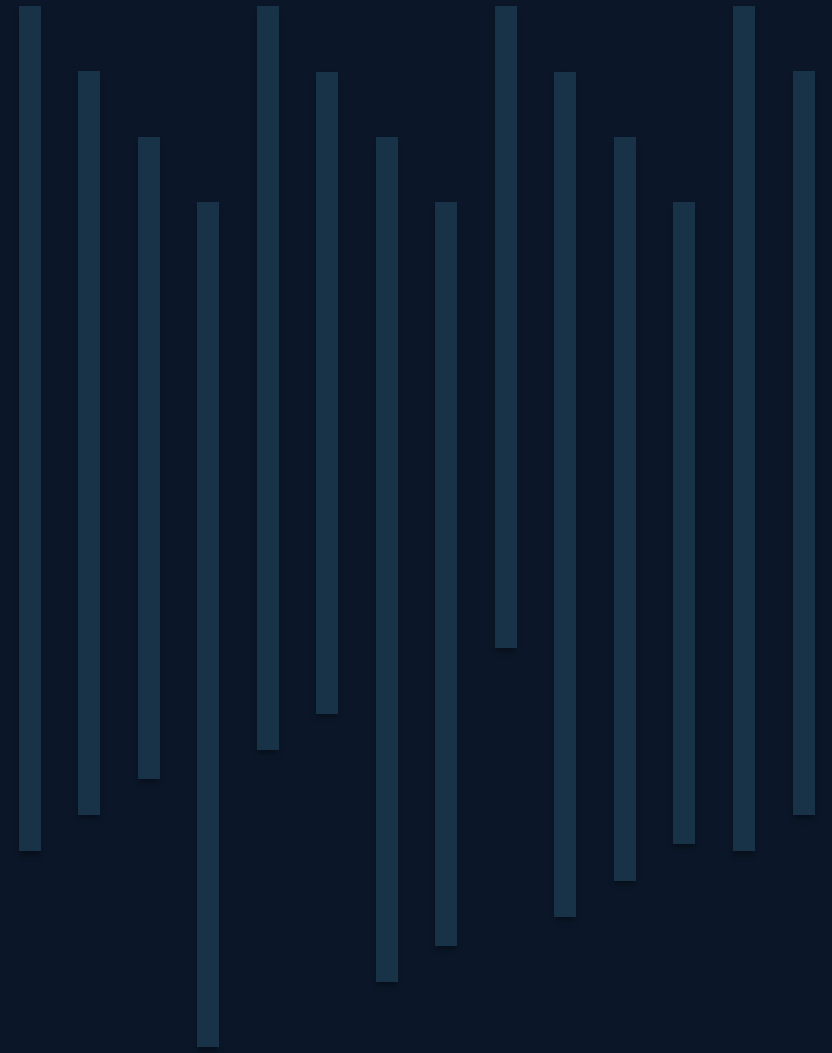
Schedule-based position estimate | Not an observed AIS position

NAM KYU PARK · LOGI AI RESEARCH INSTITUTE · OCTOBER 2026

01

The purpose and operating value

Where is the vessel likely to be along its route at a selected time?



03 / System objective

Six outputs from one voyage

Combine vessel, voyage, ETD, ETA, origin and destination to estimate a point on the route.

Operational visibility

Classify pre-departure, underway and ETA-passed status on a map

Time-based progress

Convert elapsed schedule time into progress along route distance

Explainable outputs

Route, status, progress, coordinates, sailed/remaining NM, ETA and provenance

Language matters: “estimated position / Schedule Estimate,” not “actual position.”

04 / System objective

An estimate when AIS is unavailable

Even without accessible AIS observations, schedule and route data support a bounded operational estimate.

Voyage schedule

Vessel, Voyage, ETD and ETA may exist without position reports.

Route geometry

Distance and geometry are stored independently for a port pair.

Time into position

Interpolate elapsed schedule time across accumulated route distance.

This capability is not a substitute for AIS tracking.

05 / System objective

Five questions before estimating

Position estimates begin only after voyage, route, time and provenance checks.

Q1 · Port codes

Do POL/POD resolve to the Port Master and aliases?

Q2 · Safe route

Does the registered/generated route pass sanity checks?

Q3–Q4 · Time

Is ETA after ETD? Is as-of before, during, or after the voyage?

Q5 · Interpretation

Does the user recognize a schedule estimate rather than observed AIS?

Q5 is essential: show both the evidence and the limitation.

02

Development workflow and architecture

Voyage records → route geometry → time progress → coordinate interpolation → map UI

07 / System design

Stage-first implementation sequence

Validate each calculation component independently before connecting it through the operating gateway.

01 · Data inputs

Voyage / Rotation, Port Master and alias normalization

02 · Route acquisition

Distance Master, registered route and geometry validation

03 · Estimation

ETD, ETA and as-of → progress → coordinates / course

04 · Decision interface

Map, state, sailed/remaining distance, explicit warnings

MetaShipping records remain READ-ONLY; tracking runs as a separate service.

08 / System design

From records to map status

A five-stage transformation from voyage evidence to an explainable estimated location.

Vessel / Voyage

Vessel ID, voyage, ETD, ETA

Port & Route

Port Master, distance, registered geometry

Time & Position

KST as-of → progress → cumulative-distance interpolation

Map / Status

Leaflet, lat/lon, course, status and remaining distance

ais_position_used=False | confidence=LOW

09 / System design

Input data and provenance

The provenance and validity of inputs govern how the estimate should be interpreted.

Voyage & ports

voyage_mst / rotation: REAL vs TEST; port_mast.csv aliases

Route & time

Distance Master / registered geometry / cache; ETA > ETD; KST as-of

AIS & disclosures

No AIS feed used here; preserve route_source and position source

Prefer “schedule-based estimated position” to an unqualified “current position.”

03

Position-estimation algorithm

Resolve ports → validate route → calculate time progress → interpolate distance → explain output

11 / Estimation algorithm

The sequence is part of the control

Validate geometry and the as-of time before placing any position on a map.

01 · Resolve

Canonical port codes and aliases

02 · Route

Distance, geometry and sanity checks

03 · Time

ETD, ETA and as-of → 0–100% progress

04–05 · Explain

Interpolate → show state, distance and provenance

A credible estimate begins with validated route and timing, not map decoration.

12 / Estimation algorithm

The shortest route is not a straight line

Prioritize official/registered geometry; generate only controlled missing segments.

① Port resolution

Normalize port aliases to canonical codes

② Route priority

Official/Live → Runtime Cache → Passage Selector/Generator

③ Route sanity

Temporarily densify at 5 NM and test land-crossing / passage constraints

Do not render unsafe geometry. Retain route_source and distance_id.

13 / Estimation algorithm

Calculate schedule progress

Measure the elapsed share of the ETD–ETA window and clamp to 0–100%.

Total duration

TOTAL = ETA − ETD

Elapsed duration

ELAPSED = As-of − ETD

Progress (%)

clamp(0, 100, ELAPSED / TOTAL × 100)

Stop when ETA ≤ ETD · Interpret datetime-local as KST (+09:00).

14 / Estimation algorithm

Interpolate by cumulative route distance

Map schedule progress onto the same proportion of cumulative route distance.

Target distance

Target Distance = Route Distance × Progress

Worked example

484.78 NM × 50% = 242.39 NM

Coordinate interpolation

Find the segment containing target distance; interpolate lat/lon

Separate sailed_route_points and remaining_route_points for map display.

15 / Estimation algorithm

Status semantics are as important as position

Time determines schedule state, not whether arrival has actually been confirmed.

NOT DEPARTED

As-of < ETD · 0% · origin

UNDERWAY

ETD ≤ As-of ≤ ETA · position along route

ETA PASSED

As-of > ETA · 100% · arrival not confirmed

SAME PORT

POL = POD · review invalid/special case

ETA PASSED ≠ ARRIVED | Arrival is not confirmed by this estimate.

04

User workflow

Open service → enter voyage → set as-of time → show estimated map → interpret output

17 / User operations

Service entry and authentication

Open Vessel Tracking Engine from META PORT → Vessel Tracking & Voyage Intelligence.

Service card

Check Online status and select Open Service

Application route

/tracking-v2/engine; preserve central authentication and company scope

Backend boundary

Existing port 8027 backend accessed through a trusted gateway

No separate local second-factor login is required in this workflow.

18 / User operations

Existing voyage or a new temporary voyage

Select an existing voyage from Voyage List, or use + Track New Voyage for a temporary estimate.

Existing voyage

Find a saved/linked voyage, then open Map View

Real voyage data

Read MetaShipping voyage_mst / rotation in READ-ONLY mode

Temporary input

Tracking Input does not create a persistent voyage record

Operational voyage registration and temporary tracking are distinct operations.

19 / User operations

Enter vessel identity and voyage

These identifiers support traceability and display, rather than directly changing the interpolation formula.

Vessel Code / Name

Example: RUI NENG 8 · nonblank required

Voyage No.

Example: 2619W · nonblank required

Results

Entered IDs are carried into the result and API payload

Verify the displayed identifiers against the user input.

20 / User operations

Enter ETD, POL, POD and ETA

Ports and schedule times are essential to route lookup and position estimation.

ETD / POL

2026-06-02 10:00 KST · KRPUS (BUSAN)

POD / ETA

CNSHA (SHANGHAI) · 2026-06-05 10:00 KST

Validation rules

ETA > ETD; POL ≠ POD; aliases and route sanity

Example: business code KRBUS may resolve to canonical UN/LOCODE KRPUS.

21 / User operations

Choose the position calculation time

The as-of time can describe a historical, current or future schedule scenario.

Date

2026-06-03 · KST

Time

22:00 · 24-hour clock

Meaning

Midpoint of ETD–ETA: 50% in the training example

Position Calculation Time is the estimation as-of, not a list-filter date.

22 / User operations

Show Estimated Map

The map and detail panel appear only after valid inputs are processed.

Status / Progress

UNDERWAY · 50.00%

Route / Distance

KRPUS → CNSHA · 484.78 NM

Position / Source

34.175000, 124.636247 · ETD/ETA Schedule Basis

Leaflet renders the validated /api/manual-navigation response.

23 / User operations

Read map layers with voyage status

Read the full route, sailed segment, remaining segment and estimated marker together.

Map layers

Full route / Sailed / Remaining / Estimated Position

Voyage Status

Vessel, voyage, ETD/ETA, progress, remaining distance, provenance

Navigation caution

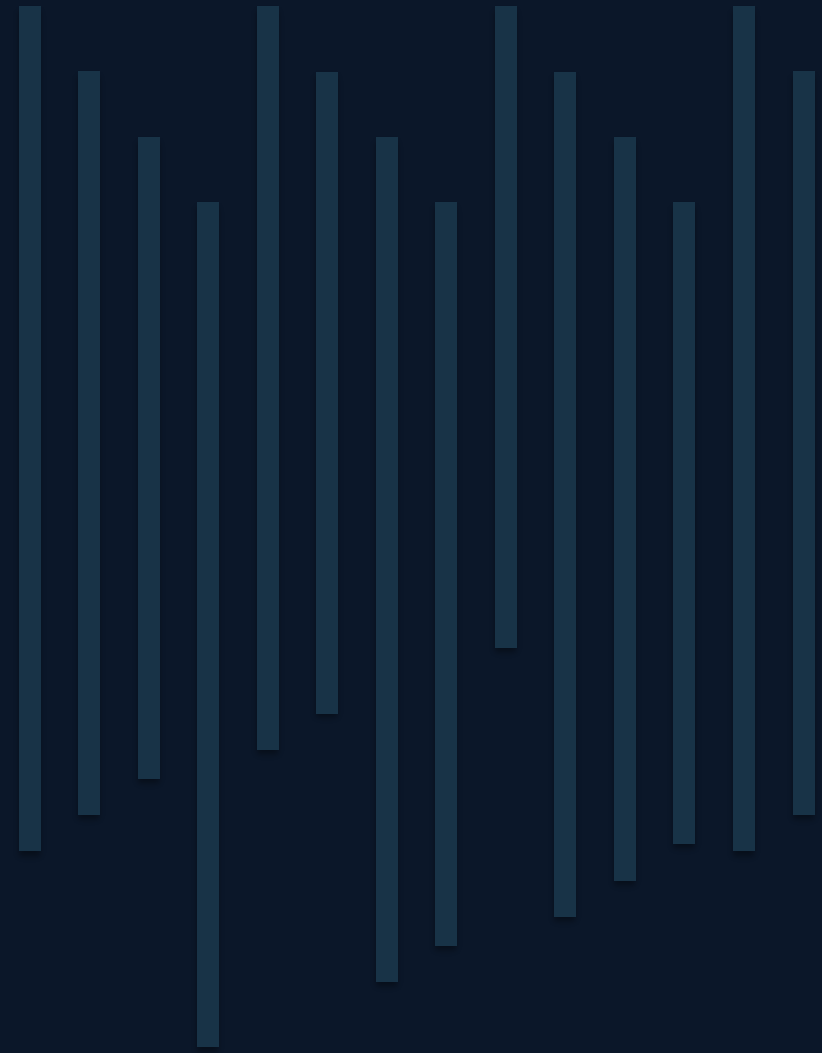
OSM, satellite and OpenSeaMap are visual aids, not navigation instructions

The estimated marker is not an observed GPS/AIS position.

05

Case study: Busan to Shanghai

A 72-hour voyage schedule, evaluated 36 hours after ETD.



25 / Worked example

Case inputs and route evidence

A registered RUI NENG 8 voyage is used to illustrate the schedule model.

Vessel / Voyage

RUI NENG 8 · 2619W

Schedule

KRPUS → CNSHA; Jun 2 10:00 → Jun 5 10:00 KST

Route evidence

484.78 NM · 152 points · DIRECT_MASTER

As-of: Jun 3, 2026 22:00 KST · No guarantee of agreement with observed AIS.

26 / Worked example

Numerical proof: time and distance

Exactly half of the 72-hour schedule has elapsed.

Total time

72 h · Jun 2 10:00 → Jun 5 10:00

Elapsed & progress

36 h · 36 / 72 = 50.00%

Sailed & remaining

Sailed 242.39 NM · Remaining 242.39 NM

This proportional assumption excludes speed changes, weather, anchoring and detours.

27 / Worked example

Estimated coordinates and state

Coordinates and estimated course are obtained at 50% of cumulative registered geometry.

Latitude

34.175000°

Longitude

124.636247°

Course / Status

270.0° estimated · UNDERWAY · confidence LOW

Position Source = ESTIMATED · ETD/ETA Schedule Basis · AIS not used

28 / Worked example

The assumptions matter more than the marker

Every explanation of the result should carry these four qualifications.

Time fraction

Progress along route distance is proportional to elapsed schedule time

Registered geometry

Use registered marine route points, not a direct straight line

Not AIS

SCHEDULE_ESTIMATE does not replace observed AIS positions

After ETA

100% estimated progress does not confirm actual arrival

Interpretation: “Based on the registered schedule and route, the vessel is estimated to be here.”

06

Operational controls and checklist

A trustworthy tracking tool prioritizes validation and limits over a convincing-looking map.

30 / Operational controls

Do not invent a position on invalid input

Stop or show explicit errors for missing data, schedule conflicts and unsafe geometry.

Input error · HTTP 422

Missing required field, POL=POD, invalid as-of

Schedule / route error

ETA ≤ ETD → stop; absent route → ROUTE_NOT_REGISTERED

Unsafe geometry

Do not render land-crossing or sanity-failed routes

Never fill missing route evidence with an approximate straight line.

31 / Operational controls

Eight-point daily operating checklist

Validate inputs, routes, interpretation and external evidence before operational use.

1–2 · ID & schedule

Correct Vessel/Voyage? ETD/ETA accurate in KST?

3–4 · Ports & as-of

POL/POD resolve? Is the selected as-of intentional?

5–6 · Route & state

Valid route source / distance ID? Is state interpreted correctly?

7–8 · Evidence

Recognize a schedule estimate? Validate against AIS / operator report?

Without item 8, never assert that the estimate is the actual current position.

32 / Training conclusion

A verifiable estimate—not just a map

Maintain one auditable sequence from input to estimation to interpretation.

① Input

Vessel / Voyage / ETD / POL / POD / ETA / As-of

② Estimate

Time progress × cumulative route distance → estimated position

③ Interpret

Status / Progress / Sailed / Remaining / Source

Final rule: an estimated position aids decisions but never automatically replaces observed AIS.