Let Me See Sea: A Vision Based Smart Surfing Area Analysis System

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Introduction

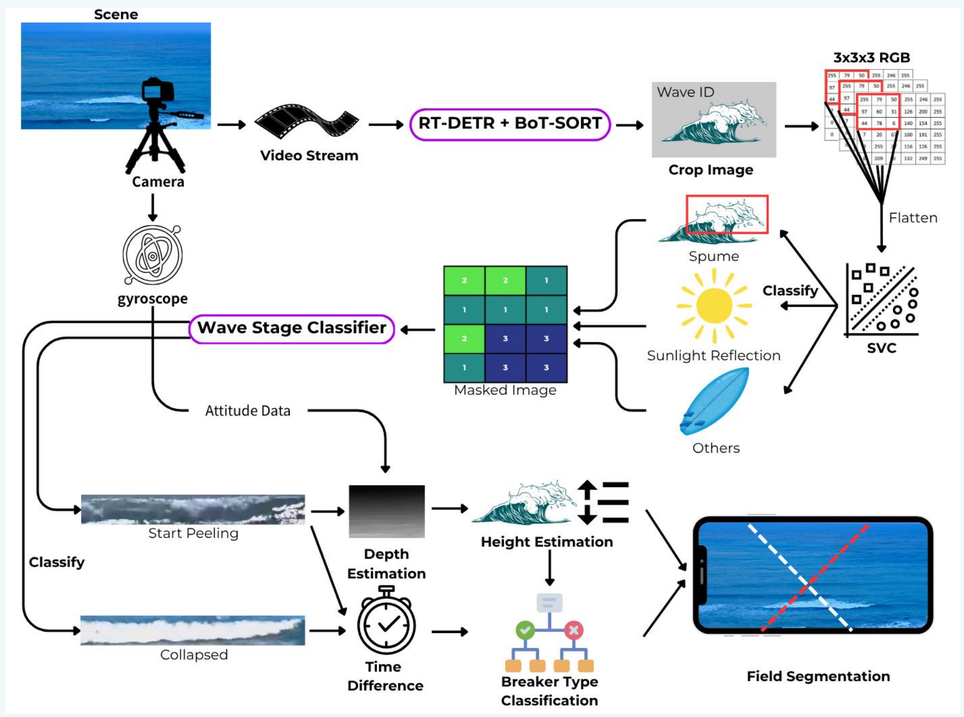
Surfing: A Booming Sports Industry.

The Challenge:

1. Surfers rely on weather apps, which sometimes fail to match actual conditions, leading to wasted trips.
2. Upon arrival, surfers still waste time visually scanning the beach to find a zone that matches their specific board.

To address these challenges, we develop a smart surfing area analysis system that quantifies and classifies wave features, optimizing every session for all surfers.

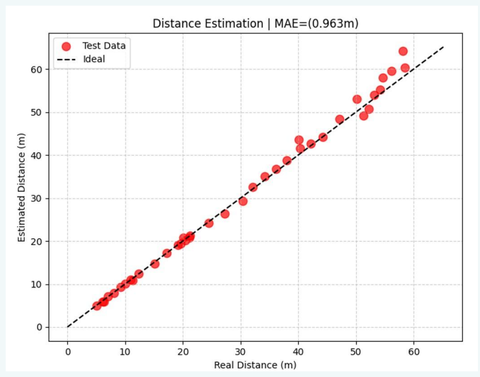
Architecture



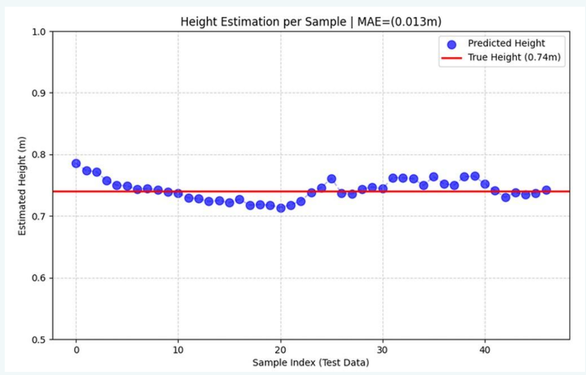
1. **Wave Tracking:** A fine-tuned RT-DETR model for per-frame wave detection with the BoT-SORT algorithm for cross-frame data association.
2. **Noise Filtering:** SVC classifies local textures to generate a masked image for calculating the spume ratio.
3. **Stage & Feature Extraction:** Classifies wave stages based on the spume ratio, and estimates wave height, time difference.
4. **Breaker-Type Classification:** Classifies the breaker type through a Decision Tree model.
5. **Field Segmentation:** Segments the surfing zone according to wave height and breaker-type distribution.

Results

Depth



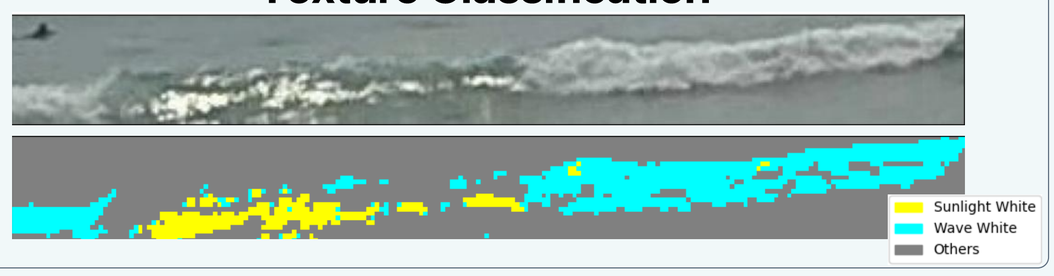
Height



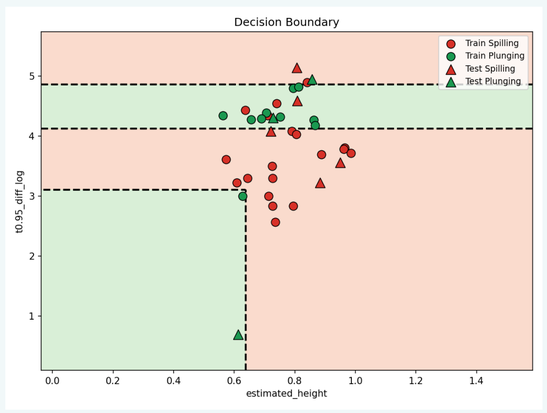
Multi-wave Detection & Tracking

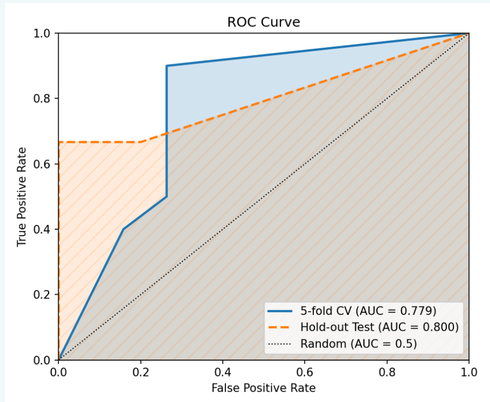
WPT (Thompson et al., 2021) | Ours

Texture Classification

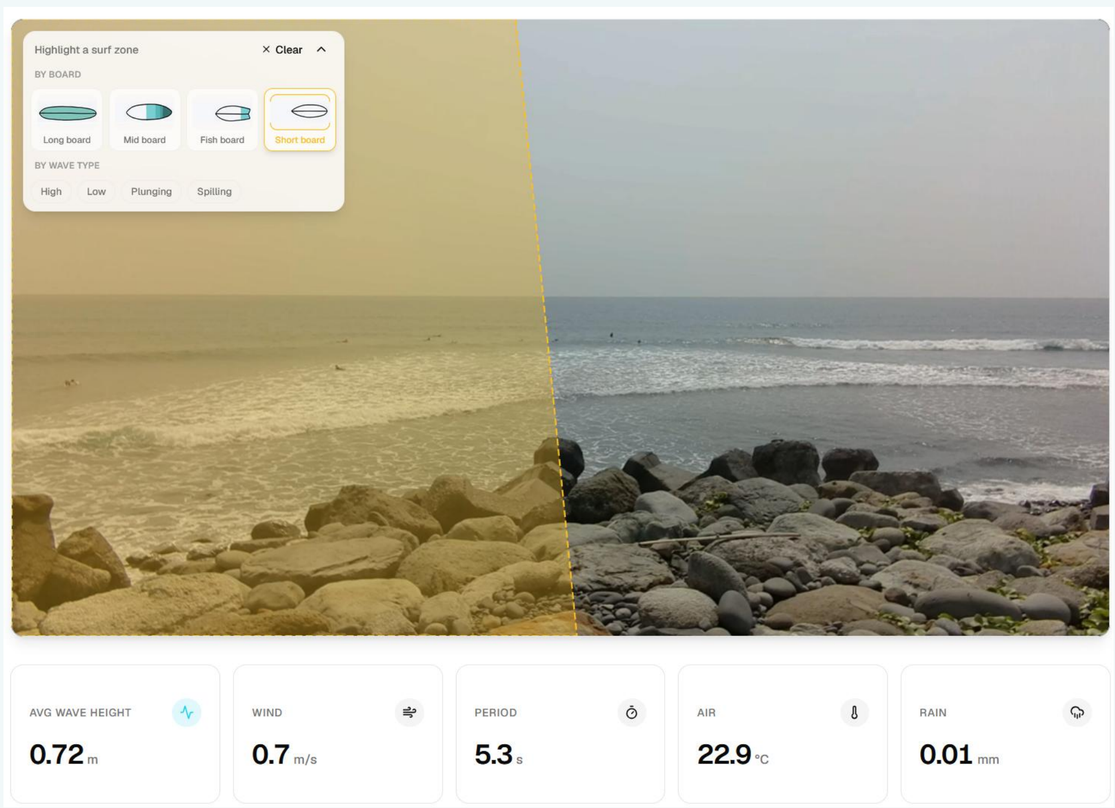


Breaker-type Classification





Web Application



Conclusion

What We Achieved:

- **Robust AI Tracking:** Integrated RT-DETR + BoT-SORT and SVC to overcome marine noise and accurately classify wave types.
- **Precise Quantification:** Achieved centimeter-level wave height estimation using monocular depth modeling.
- **Ultimate Surfing Hub:** Developed a one-stop web platform designed to replace generic weather apps by providing precise, user-centric wave zoning.

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