RivAIr | AI-based drone observations of flow-form interactions in rivers

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Our Lab & Real time demo

Data Community

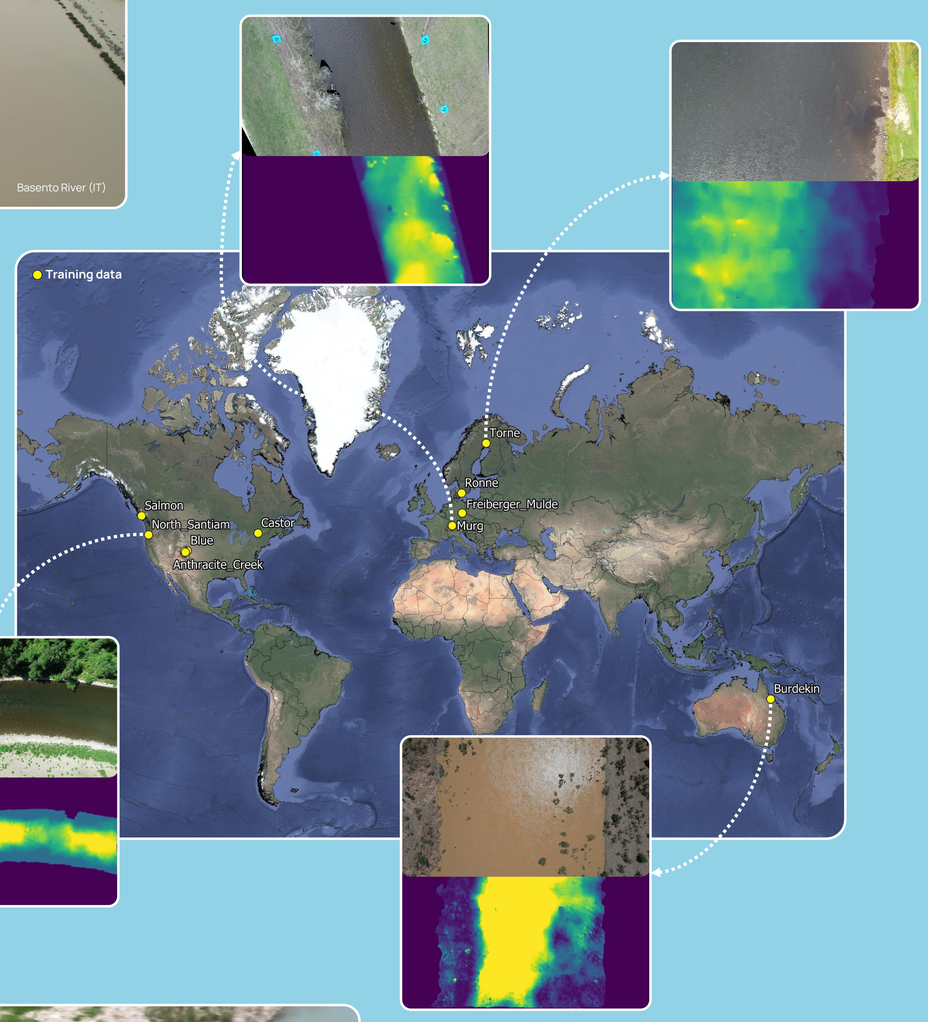
RivAIr v1.0 Earlier prototype

1 Why do we need a new approach?

Climate change is increasing the frequency and intensity of river floods, making fast, accurate and high-resolution spatio-temporal observations essential for flood risk mitigation. Yet, traditional (in-situ) methods are often impractical during extreme events, while satellites provide infrequent observations and cannot capture detailed event dynamics.
This limits our ability to see how flow reshapes form, and form redirects flow, during floods.

2 Learning from rivers worldwide

Rather than learning from synthetic scenes, RivAIr learns from real rivers imagery (YOLO segmentation), and videos (RAFT optical flow), collected across diverse hydrological and environmental conditions, capturing the variability of real flow-form dynamics.
Videos are calibrated against in-situ ADCP measures extended across the water surface via a confidence weight that decays smoothly away from the ADCP cross-section .



3 RivAIr: beyond usual surveys

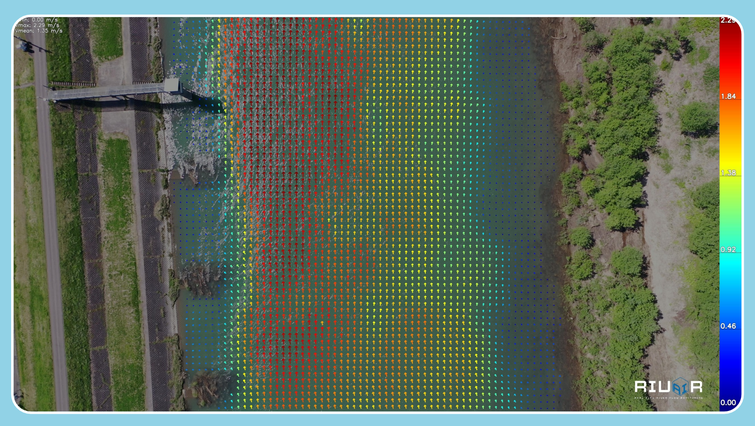
An onboard edge-computing device integrates the fine-tuned YOLOv11 and RAFT-small models into a single real-time workflow, by transforming drone imagery into quantitative flow-form data as conditions evolve during flight.

Image frames
Water detection
Water mask
Flow velocity

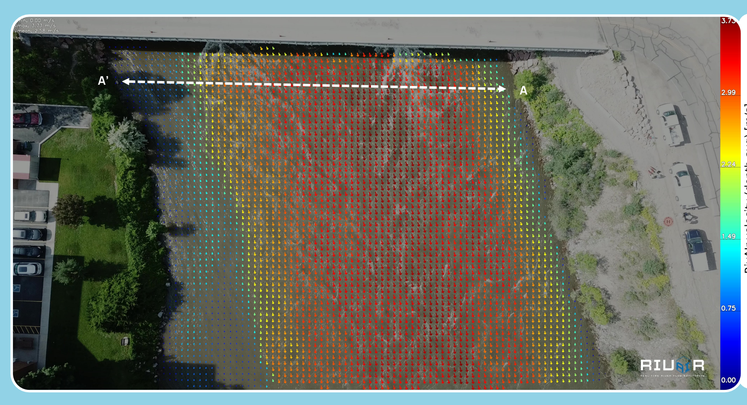
Water-body segmentation first clearly delineates channel form, constraining optical flow to the river water surface for physically-consistent extent and velocity mapping, computed in-flight and streamed live to the ground unit.
Field-tested: drone–ground link >1 kilometers line-of-sight, on-board inference cycle ~5 seconds end-to-end.

4 Off-line test (third-party videos)

Uono River (JP): ConfScore water mask 0.95, avg surface velocity error of river reach (vs ADCP+drone avg) 1.50%.

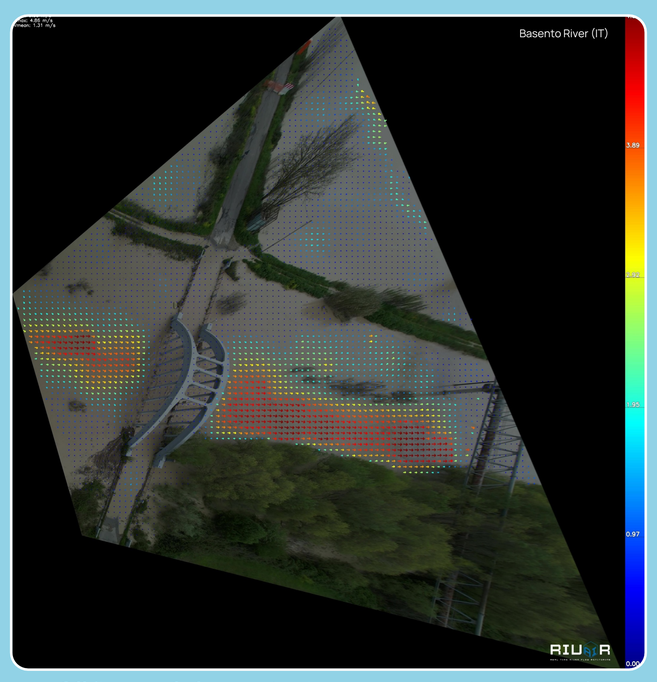


Colorado River CRG (US): ConfScore water mask 0.96, MAPE ~13% (vs ADCP depth-avg velocity along a cross section).



5 Flow-form dynamics

During floods, rising water erodes and reshapes the bed, while the evolving channel redirects the flow. RivAIr observes this in real time, streaming live signals that guide surveying, tracking bed scour, bank instability and floodplain connectivity, to support flood risk and river evolution studies.



Off-line proof of concept: bridge scour hotspot and channel–floodplain connectivity, as described above.

References

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