Refactor Index (RI) for Water Quality

The Refactor Index (RI) is a composite measure designed to represent water quality on a scale of 0–100.
It uses parameters from commonly available water quality sensors, such as turbidity, pH, and dissolved oxygen (DO).

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1. Definition

The RI provides a simplified, dimensionless score where higher values indicate better water quality, while lower values suggest deterioration. It is particularly useful in real-time monitoring systems.

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2. Equation

The simple equation for calculating RI is:

$$RI = 100 \times (1 - Turbidity / NTU\_max) \times (1 - |pH - 7| / \Delta pH) \times (DO / DO\_ref)$$

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3. Parameters

- Turbidity (NTU): Measured turbidity level of the water.
- NTU_max: Maximum expected turbidity (e.g., 1000 NTU).
- pH: Measured pH of the water.
- ΔpH: Acceptable pH deviation from neutrality (commonly set to 3).
- DO (mg/L): Measured dissolved oxygen in milligrams per liter.
- DO_ref: Reference dissolved oxygen considered healthy (commonly set to 9 mg/L).

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4. Example Calculation

Suppose the following measurements:
- Turbidity = 50 NTU
- pH = 7.5
- DO = 6.0 mg/L
- NTU_max = 1000, ΔpH = 3, DO_ref = 9

Step 1: Turbidity factor = (1 - 50 / 1000) = 0.95
Step 2: pH factor = (1 - |7.5 - 7| / 3) = 0.833
Step 3: DO factor = (6 / 9) = 0.667

$$RI = 100 \times 0.95 \times 0.833 \times 0.667 \approx 52.8$$

Therefore, the water quality index is approximately 53, which corresponds to moderate quality.

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5. Interpretation

- $RI \geq 80$: Good water quality
- $50 \leq RI < 80$: Moderate water quality
- $25 \leq RI < 50$: Poor water quality
- $RI < 25$: Bad/Unsafe water quality

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6. Applications

- Drinking water monitoring
- Aquaculture systems
- River/lake health assessment
- Smart IoT-based water monitoring systems

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7. Notes

- The equation can be expanded to include other parameters such as electrical conductivity (EC), temperature, or total dissolved solids (TDS).
- Thresholds for interpretation may be adjusted depending on the use case (e.g., drinking water vs. irrigation).