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Limnimeter for Mountain Streams

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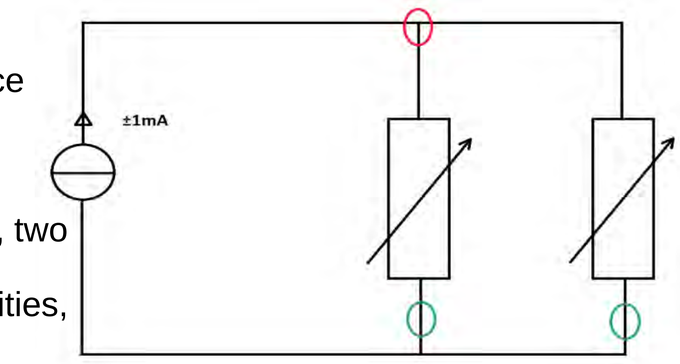
1. What is the problem?

- Mountain streams do often have a complex bed which can evolve over time, since the water transports sediments. Parts of the bed may be eroded, and sediments can be deposited in other places. The measurement of water depth is therefore not complete when the upper limit of the streams, it's interface with the air is determined, as e.g. a radar shall do. Ideally, the water bed level should also be measured. Typical mountain stream with glacial regime may show depth fluctuations of 1m during a season, sometimes even more.
- The measurement should yield an electric quantity to be able to acquire and record it with a data-logger.
- The properties of mountain waters are fluctuating, e.g. turbidity, electrical conductivity, temperature. A new measurement method should be intrinsically independent of such variations. Further on, a water depth sensor shall be robust enough to withstand the impact of solid material carried along by the water flow.

2. New limnimeter

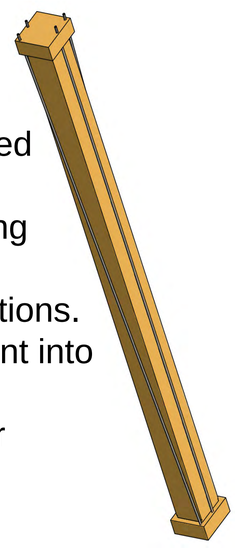
To address the requirements enumerated above, we propose to determine water and sediment levels based on the measurement of a differential electric impedance variation:

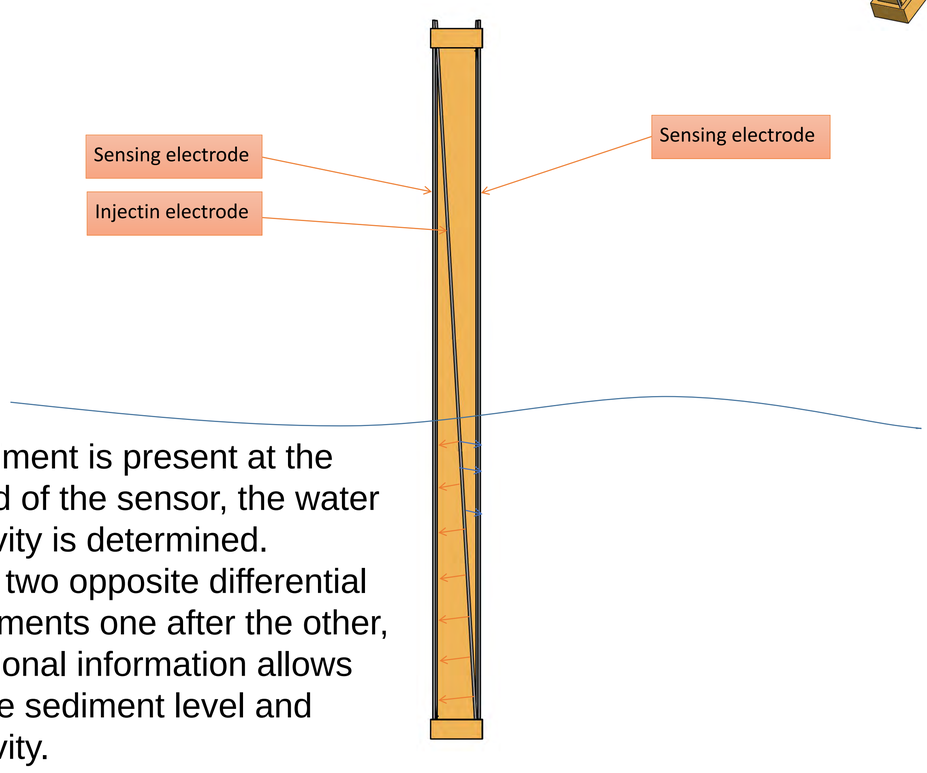
- A rectangular electric current of fixed frequency is injected into a measurement circuit made up of 2 parallel impedances.
- Depending of the variation of water and/or sediment level, the ratio of the two impedances shall vary, i.e. one increases and the other decreases.
- Because of the differential measurement, the influence of water conductivity is cancelled.
- By making two different differential measurements, two layer thicknesses with two different electric conductivities, e.g. water and sediments can be discriminated.



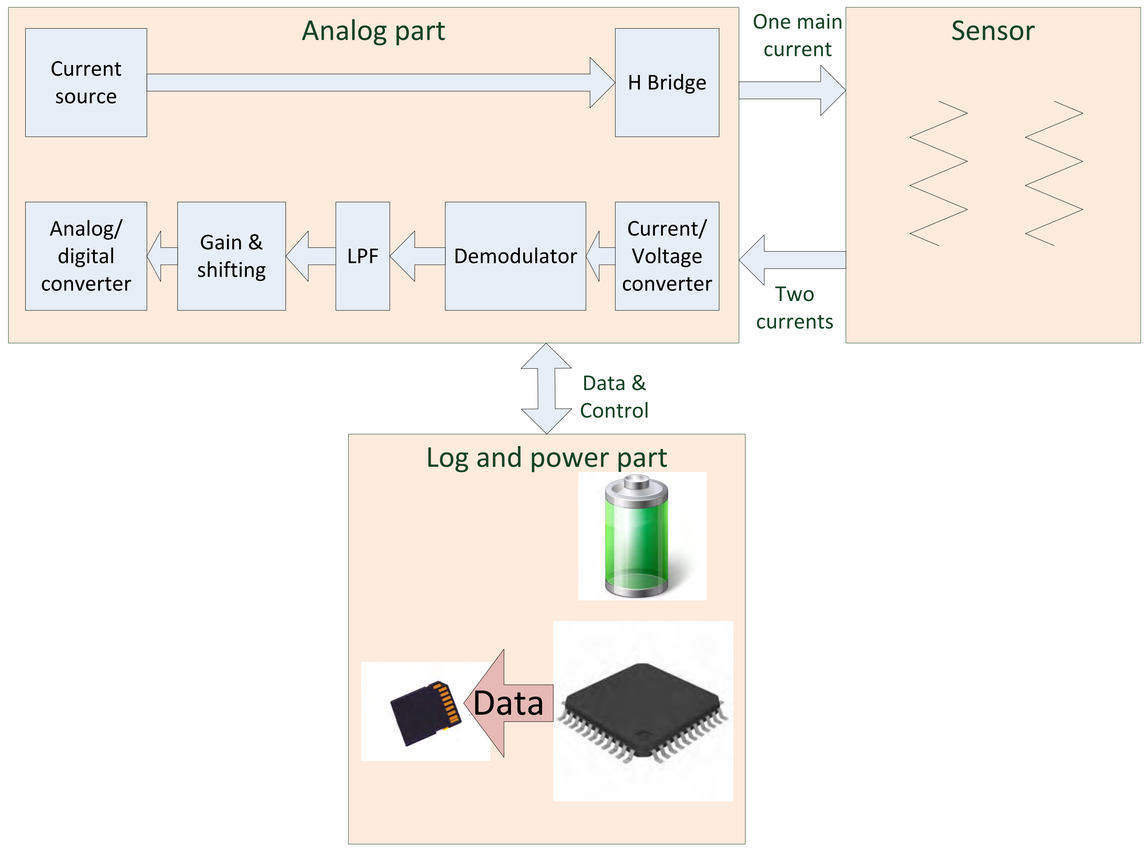
3. Sensor concept

- The sensing element is made up of 4 electrodes grouped around a central non conducting support column.
- Two of the electrodes are vertical. These are the sensing electrodes.
- The other two electrodes are inclined, in opposite directions. These are alternately used to inject the excitation current into the water.
- Depending on the water level, the ratio of the two water impedances between the electrodes is modified.





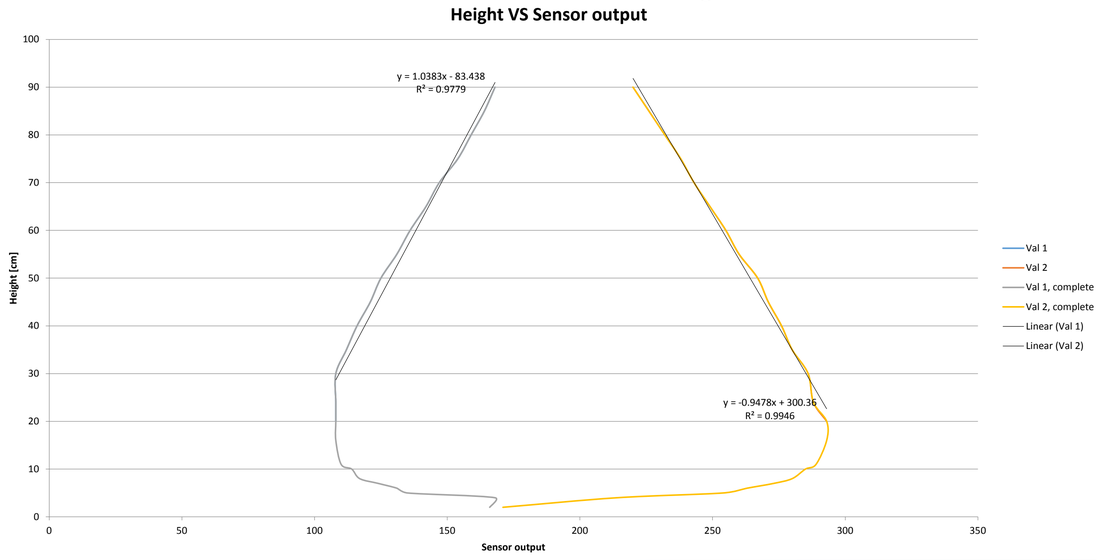
- If no sediment is present at the lower end of the sensor, the water conductivity is determined.
- By doing two opposite differential measurements one after the other, the additional information allows determine sediment level and conductivity.



The figure above shows a block diagram of the sensing acquisition, processing and recording / read-out electronics.

4. Limnimeter calibration

Calibration of the sensor demonstrator in a laboratory water reservoir with variable depth, shows that the sensing curve may be linearized over about two thirds of the measurement range.



5. Demonstrator installation

A demonstrator of the proposed water and sediment level sensing system is currently installed in the Naviscence river at Crealp's Zinal measurement station.