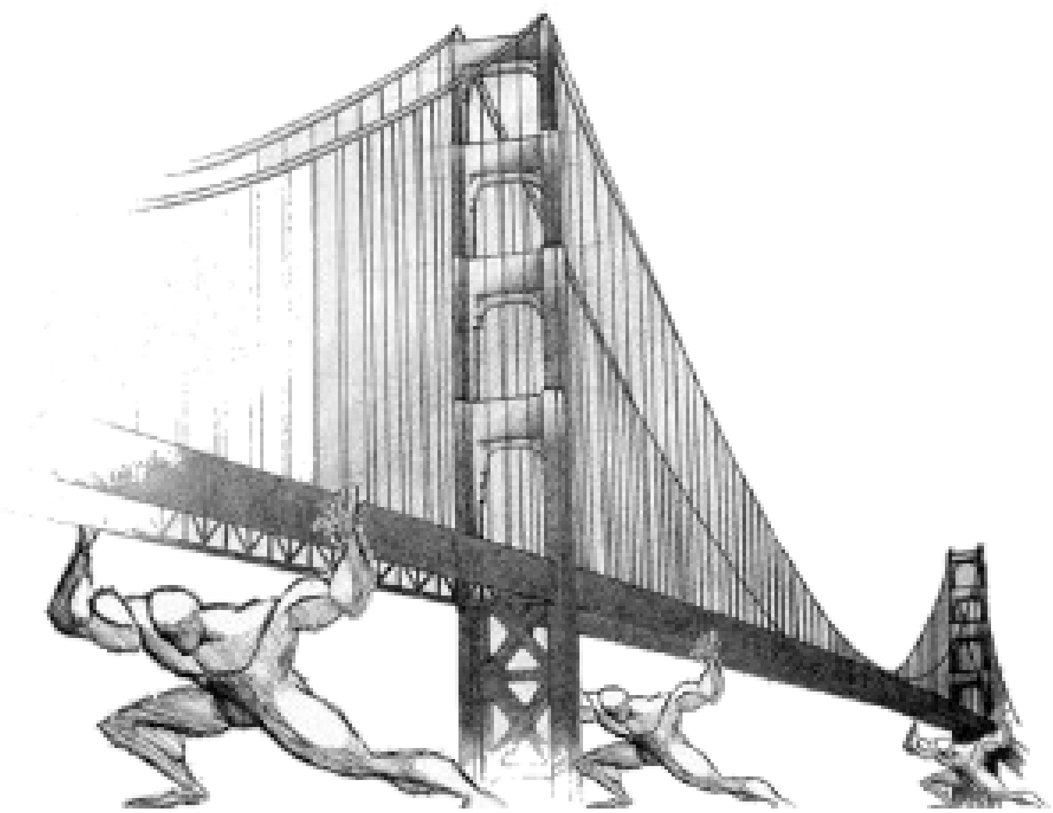
Real-time Bridge Monitoring

Guide to Inputs Conversion & Formulas calculation



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1. Type of Inputs

here are three inputs:

- *analog*********.txt* → in this txt file there are the values measured by the *Anemometer* and the *Hydrometer*
- *sonar**********.txt* → in this file there are the values measured by the *Echo Sonar*
- *Modean[Mantova]********.jpg* → there are the pictures taken by the two camera

How to interpret the ID/timestamp of a file

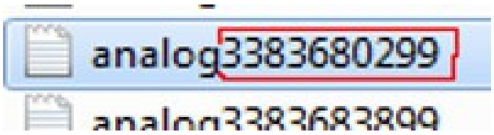
analog******.txt***
sonar*******.txt***

For this two kind of files the ID represents the Labview encoding and corresponds at the number of seconds that have elapsed sing 1th January 1904, without time zone so on the meridian of Greenwich (and at the same way for the timestamp of the all values in the file)
http://www.ni.com/white-paper/7900/en/

(there are 2 file (.xlsx & .ods) on GitHub [DSD/Data Source] that do this conversion automatically, just insert the number of seconds in the cell)

Example

File: analog3383680299.txt



(fig. 1)

s = 3383680299 ← fig. 1
m=(3383680299 / 60) = 56394671
h = (56394671 / 60) = 939911
d = (939911 / 24) = 39162
y = (39162 / 365) = 107

*rest of days = d - (y*365)=107*
*rest of hours = h - (d*24)=23*
*rest of minutes = m - (h*60)=11*
*rest of seconds = s – (m*60)=39*

The rest of days is 107, and it's corresponds at the month of April because 107 is between the sum of the days till March(that is 90) and the sum of days till April (that is 120). So mean that 107 days remaining corresponds at the month of April, the 4th.

How many days in April? Easily April begin after 90days so 107-90=17days elapsed.

Ok, here we are:

	Day 0	+	results	
y =	1904	+	107y	= 2011
m=	0	+	04m	= 04
d =	0	+	17d	= 17

h = 00 + 23 = 23 h
m= 00 + 11 = 11 m
s = 00 + 39 = 39 s

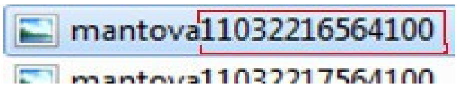
*At the end we have converted **3383680299 → 2011/04/17 at 23:11:39** on meridian of Greenwich, so for Italy, Sweden and Croatia time (UTC+1) just add +1h at the time to have to correct one.*

Modean[Mantova]*****.jpg***

For the pictures the ID represents the exact date and time when the picture is taken

Example

File: mantova<u>11032216564100</u>.jpg



(fig. 2)

(fig. 3)

As you can see in fig. 3 this picture is taken on 22/03/2011 (DD/MM/YYYY) at 16:56:40 (hh:mm:ss)

So this information are used to build the timestamp of the file, in this way:

Y = 2011 → 11 take only the last two number of the year
M= 03
D = 22

h = 16
m= 56
s = 40

concatenating all these numbers we obtain:
Y|M|D|h|m|s
110322165640

So if we compare this result and the file ID
110322165640 ← concatenation of values
11032216564100 ← timestamp of the file
is the same value except for the last two numbers that we can discard
As you can see, this file was saved just 1sec after the picture was taken.

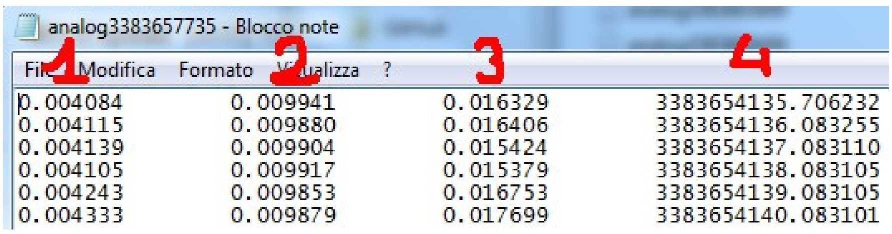
Concluding, we can extract the date&time when a picture was taken, just reading the file ID.

2. Content of Inputs

2.1. Analog files

The analog file contains 4 columns of values (*fig.4*):

1. **Wind speed** (unity measure mA)
2. **Distance between the Hydrometer and the level of water** (unity measure mA)
3. **Wind direction** (unity measure mA)
4. **Timestamp of the detection of the sample** (Labview encode → see before)[*decimals can be dropped]*



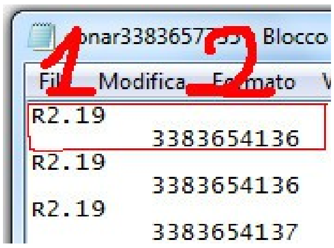
0.004084	0.009941	0.016329	3383654135.706232
0.004115	0.009880	0.016406	3383654136.083255
0.004139	0.009904	0.015424	3383654137.083110
0.004105	0.009917	0.015379	3383654138.083105
0.004243	0.009853	0.016753	3383654139.083105
0.004333	0.009879	0.017699	3383654140.083101

(fig. 4)

2.2. Echo Sonar files

The sonar file contains 2 columns of values, offset of a line (*fig.5*):

1. **Distance between the sonar and the bottom of the river** (unity measure meters)
2. **Timestamp of the detection of the sample** (Labview encode → see before)

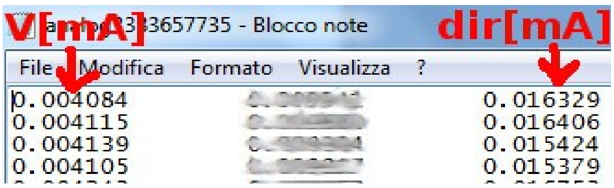


(fig.5)

3. Conversion operations on inputs

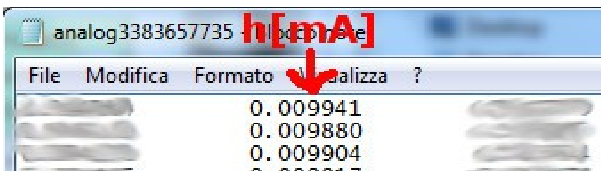
Every hour the system receives a packet in which there are an analog file, a sonar file both with 3600 values and two images, one for camera. All these values are to be converted from the parser into the db, in the table of *Raw_data(1sec)*. Each values has to fill one row of the table.

3.1. Anemometer



- Speed → $V[{}^{m}/_{s}] = \left(\left(\left(V[mA] * 1000\right) - 4\right) * 3.75\right)$
- Direction → $dir[°] = \left(\left(\left(dir[mA] * 1000\right) - 4\right) * 22.5\right)$

3.2. Hydrometer



- Distance hydrometer-water → $h[m] = 20 + \left(\left(\left(h[mA] * 1000\right) - 4\right) * (1.25)\right)$
- Water depth → $h_{water}[m] = 29.86 - h[m]$

3.3. Sonar

For the sonar is a little bit more complicated because the sonar can produces five different kind of data.

1) **Correct data** → **Rxx.xx** *(can exist even one decimal)*
2) **Uncertain data** → **Rxx.xxE** *(can exist even one decimal)*
3) **Wrong data** → **xx.xx** *(can exist even one decimal)*
4) **Sonar out of water** → **R99.99E**
5) **Error** → **E1 or missing data**

R2.19	3383680627
R4.11E	3418678328
9	3383680636
R99.99E	3423604270
	3418678324

The generic xx.xx is the distance in ***meter*** between the sonar and the height of the bottom.

- Height of the bottom → $\boldsymbol{h_{bottom} = 12.33 - xx.xx[m]}$

Data that are of type ① and ② can be convert in a real height; for the other types this conversion is not possible but is necessary to store these information anyway, to compute some statistics that will explain later.

4. What kind the calculations are there to do?

To aggregate data for 10 minutes we have to manage 600 data as a single sample to calculate the needed information.

4.1. Anemometer (10min)

- [ANE1] mean wind speed
- [ANE2] maximum wind speed in the 10 minutes
- [ANE3] mean wind direction
- [ANE4] direction of the maximum wind speed in the 10 minutes

4.2. Hydrometer (10min)

- [IDRO1] mean water depth/water height
- [IDRO2] variance of the sample

4.3. Echo Sonar (10min)

- [SONAR1] mean value of the height of the bottom (only with data of type ① + ②)
- [SONAR2] variance of the sample (only with data of type ① + ②)
- [SONAR3] % of data of type "① + ②" used compared to the 600 elements of the sample
- [SONAR4] % of data of type "③" there are in the sample
- [SONAR5] % of data of type "④" there are in the sample
- [SONAR6] % of data of type "⑤" there are in the sample
- [SONAR7] % of data of type "②" there are, considering as sample the "① + ②" set of data (so not all the 600 data)

4.4. Images

The images don't need any kind of elaboration, they have only to be displayed.

5. Civil engineering Formulas

… Coming soon …