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# MARTe real-time acquisition system of a Two-Color Interferometer for electron density measurements on FTU (Frascati tokamak upgrade).

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**Introduction**

In this work we presented a new real-time acquisition system of a two-color interferometer (Figure 1) installed on FTU that calculates, in real-time, the density along 2 fixed SIRIO (off-line density elaboration system) chords: central chord (CH3) at 0.935 m and external chord (CH4) at 1.17 m. sampled at 200 Khz.
The electron density provided by the CO_2 and CO lasers, of a two-color interferometer, discussed ref.[1] can by computed on-line by eq.(1) during the pulse by MARTe framework running under a Linux operation system.

**Procedure**

For the acquisition of interferometric data we adopted an industrial controller with two high speed acquisition boards and one Reflective Memory (RFM) module.
The two board are externally synchronized by the gate signal (synchronizing all FTU devices).
The first board DAQ has been devoted to the acquisition of four channels (sen(q), cos(q) for CO2 and CO lasers) to evaluate the central chord CH3 and similarly other four channel for the CH4 are acquired by the second one. Each one-half millisecond the system acquires 100 samples for each channel, and then read the plasma current, calculated by the real-time Feedback control system, using the RFM.

As first, the software corrects the sine and cosine signals removing the offset from the two probing beam laser, then computes the CO_2 and CO phases of the probing laser beam and finally the electronic density with an average over 0.5 ms is computed using eq.(1) and distributed using the RFM module.

**Results**

The Acquisition (200 Khz) and the density elaboration (2 Khz) has been successfully tested more than 60 shots with a wide range of plasma parameters during the last experimental campaign.

In Figure 2 the comparison of the line density evolution elaborated by MARTe framework, SIRIO system and the actual real-time density elaboration system re-sampled by rtfeed1 system (solid blue line) is shown.
The mean value of the executions time of our RT system is $500\mu s$ and his variance, show in Figure 3 (b) and (d), is almost negligible ( $\approx 10^{-35}$).

In Figure 2 we also show the density profile(blue line) of the existing real-time system as we can see our density (black line and cyan line) doesn't exhibit the time delay and has the same density profile of SIRIO density elaboration.

**Conclusions**

The measure of the density using two LOS was successful computed during the last experimental campaign as show above. The next step will be the elaboration in real-time of the Two-color medium infrared scanning interferometer described in (ref.[3]). The use of such scanning interferometer will allow to improve the estimation of the runaway beam radial position in real-time enabling robust runaway beam suppression strategies (\ref.[4] and [5]).

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