Feedback on the Tested Force Reconstruction Algorithms

Figure 1 illustrates the results of real-time testing of the force reconstruction algorithm provided by UNIGE in UPC using the Triago robot, with sensor arrays integrated on both clamps. The experiment followed the predefined protocol in which a rigid object was grasped by grasping, held for a short duration, and then released. The results show that the algorithm failed to correctly detect the release event and, as a consequence, did not reset the integral signal.

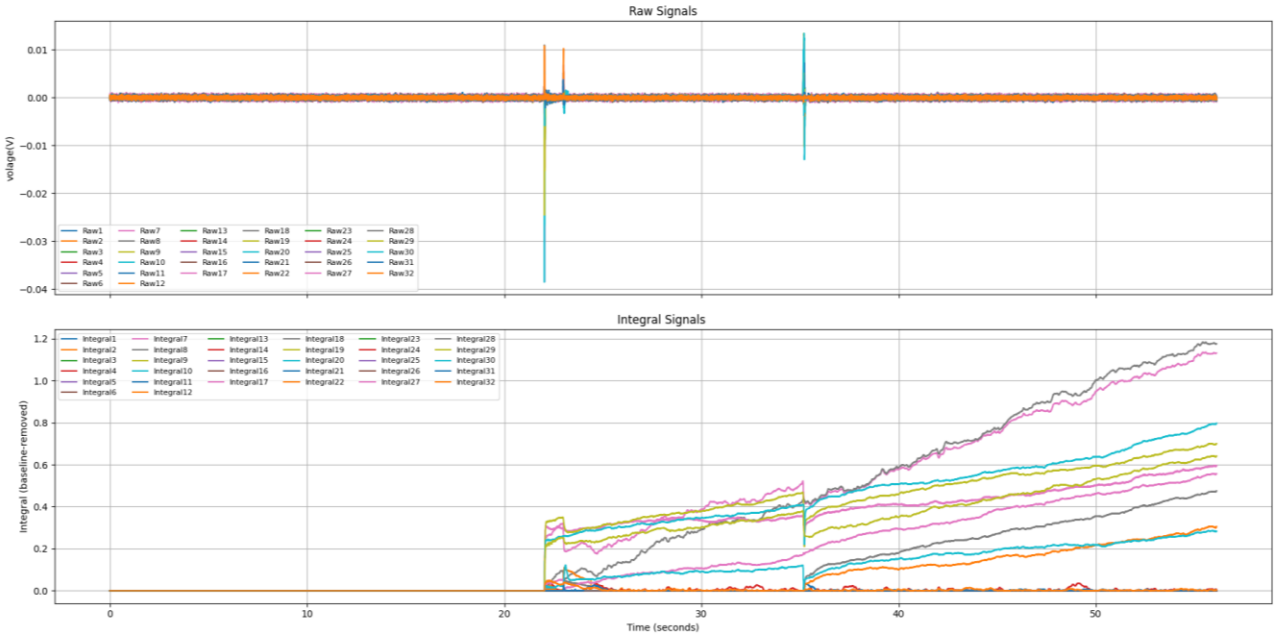

Figure 1. Results of the real-time force reconstruction from UPC.

We investigated this issue on our side and found, as discussed during the meeting, that the problem is mainly attributed to the relatively low transmission rate in the system that is currently used by UPC, which is approximately 510 samples per second. As previously pointed out by Pol, the algorithm was not detecting the release event, and during the meeting, Mohamad suggested reducing the window size to 100 samples. However, after conducting a systematic analysis to determine the optimal window size, we found that an even smaller window is required. Specifically, setting the window size to 20 samples yields significantly better performance.

The results obtained with a 20-sample window are shown in Figure 2. As can be observed, the algorithm more reliably detects the release event and correctly resets the integral signal. **Therefore, we kindly ask you to update the window size in your implementation to 20 samples.**

Additionally, **@pol**, after receiving the last detected release window state, we introduced a minor modification to further improve the robustness of the algorithm. Specifically, within the subsequent 20 samples following the release event, the algorithm should verify whether the raw sensor signal is surpassing the thresholds. If the signal does not exceed this threshold, the integral should be reset to zero.

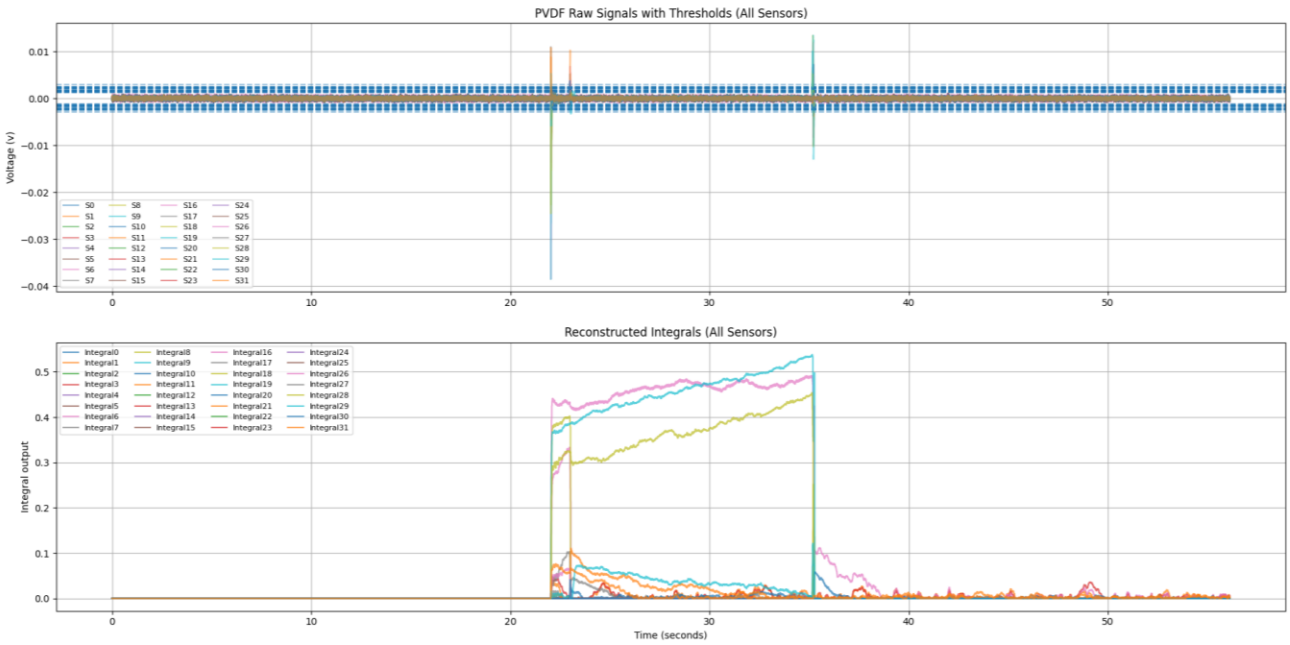

Figure 2. Results of the refined force reconstruction algorithm from UNIGE.

UNIGE requests to UPC

To further strengthen the validation of the proposed algorithm under the new experimental configuration, we kindly request your support with the following activities:

1) Extended Data Collection for Algorithm Validation

We propose collecting an additional dataset to ensure the robustness and reproducibility of the results obtained with the updated configuration (window size = 20).

Experimental protocol:

- Perform a series of trials following the previously established experimental protocol, consisting of grasping a rigid cube, holding it steadily, and subsequently releasing it.
- In contrast to earlier experiments, we kindly ask that the grasping **speed** and **force** be varied systematically, if it is possible.
- Specifically, we propose:
  - Five sets of trials for each grasping speed across different force levels, and
  - Five sets of trials for each force level across different grasping speeds.

2) Analyze the source of the unexpected peak

To better understand the origin of the unexpected peak highlighted by the dashed black ellipse in Figure 3. We would greatly appreciate your assistance with the following:

- Please record a video during data collection, as closely as possible with the sensor. This will help determine whether the observed peak arises from:
  - Physical contact with the sensor,
  - An experimental artifact (e.g., unintended contact with the flat wires during data acquisition).
- In parallel, and with your collaboration, we will attempt to identify whether the peak may be attributed to mechanical noise originating from the robot itself.

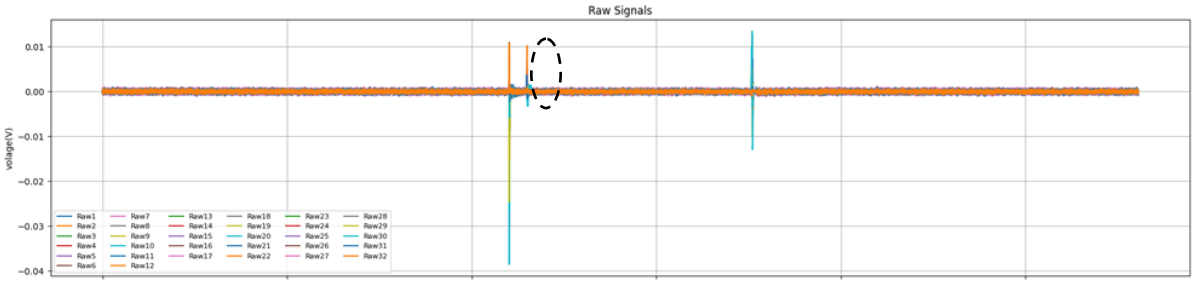

Figure 3 Raw data collected from UPC.