

Delay in Electromagnetic Tracking System

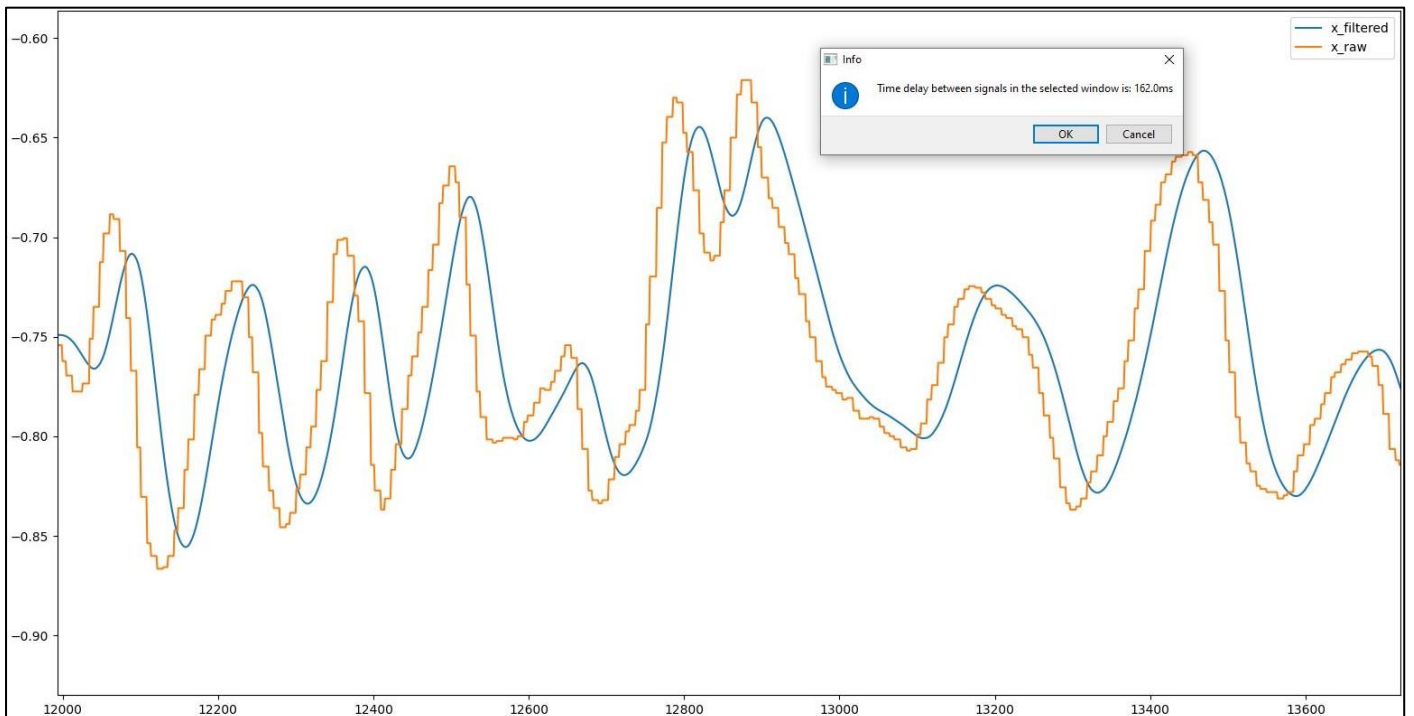
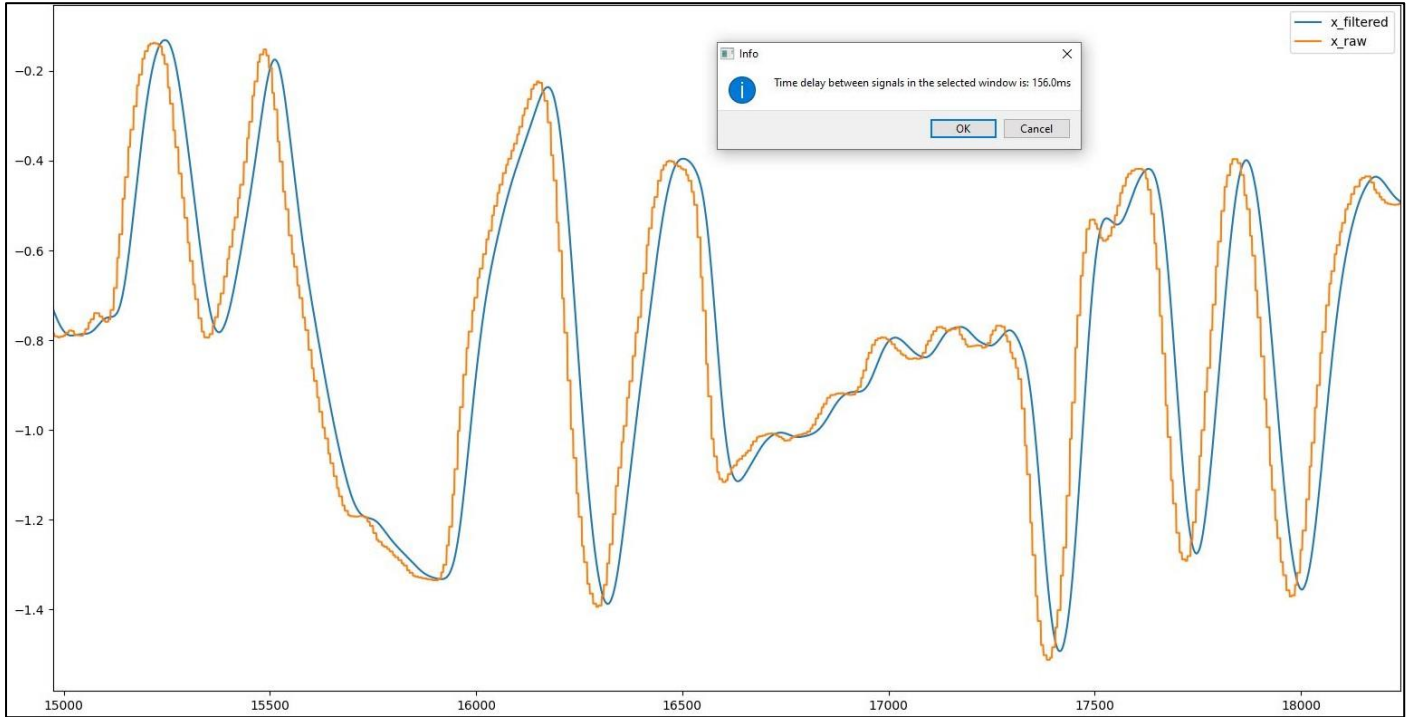
Abhinay Kumar | 21-03-2024

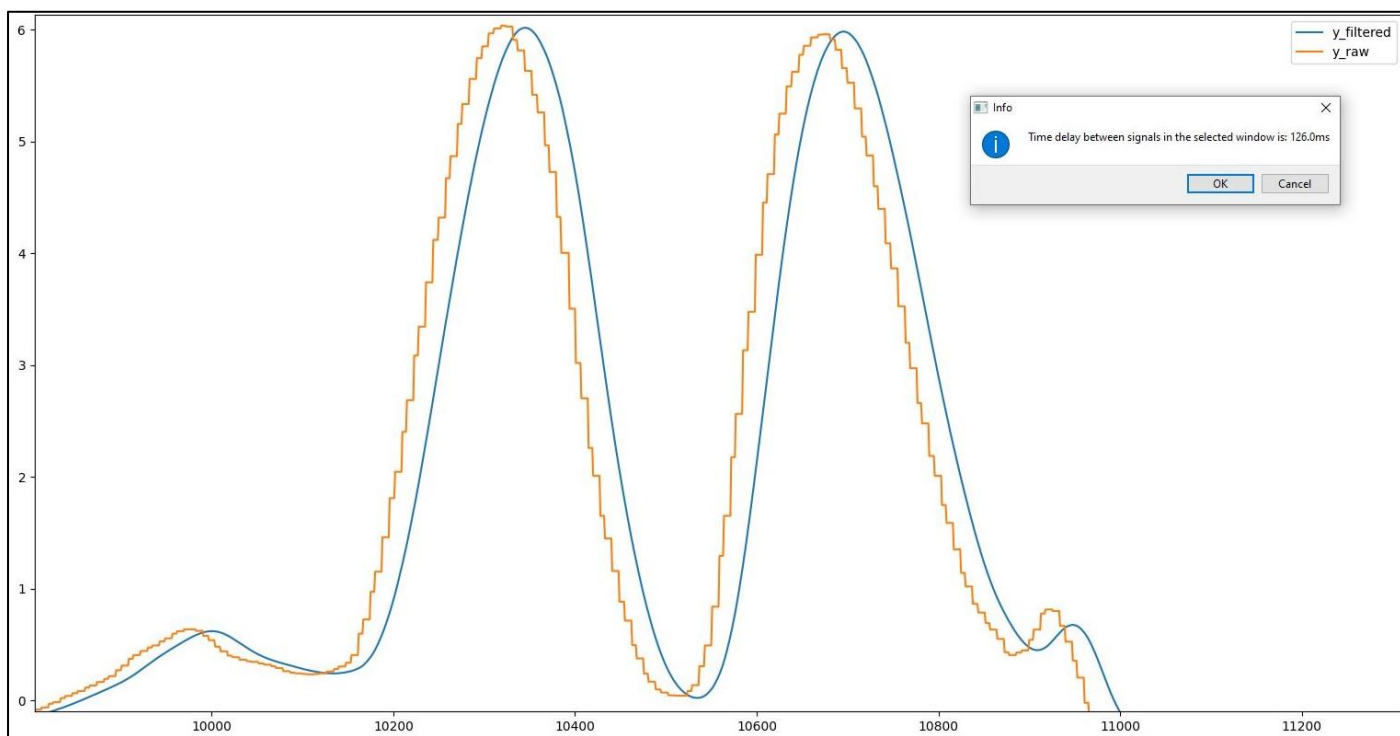
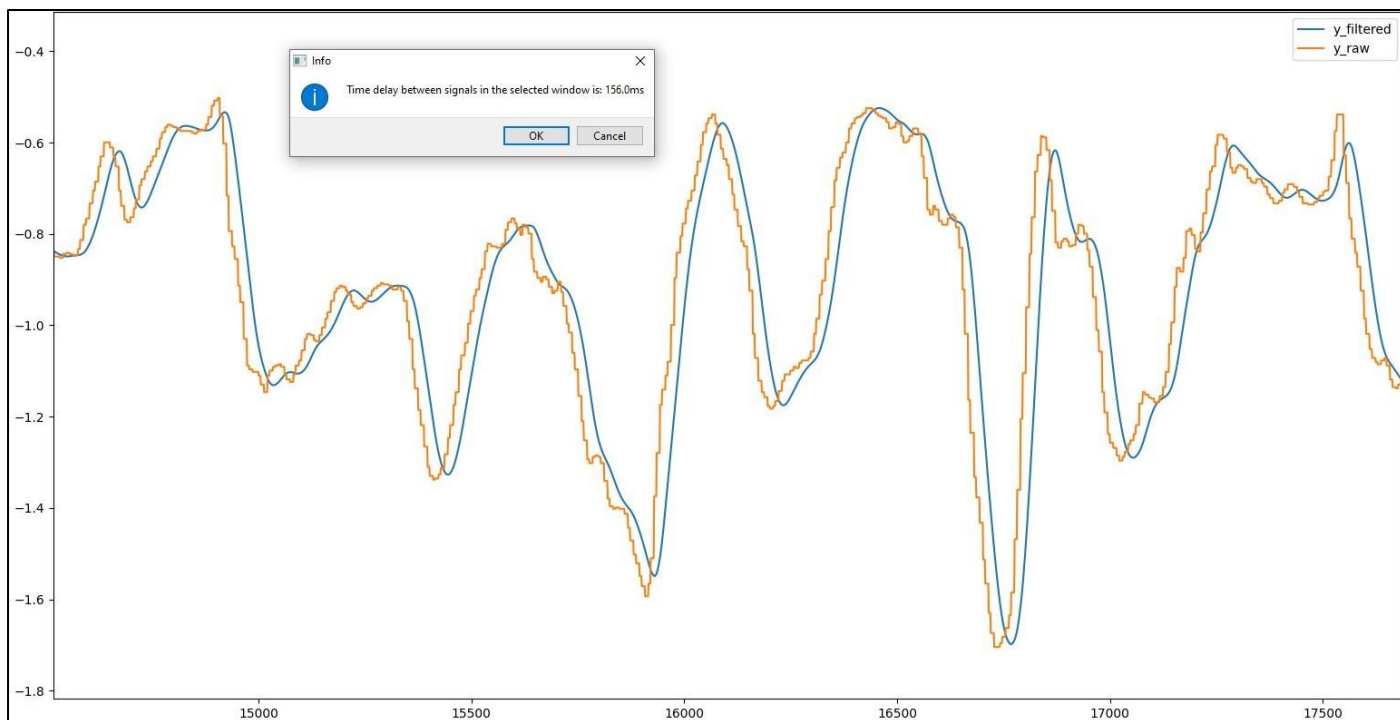
Observations and solutions for reducing time delay in interfacing NDI tracking device.

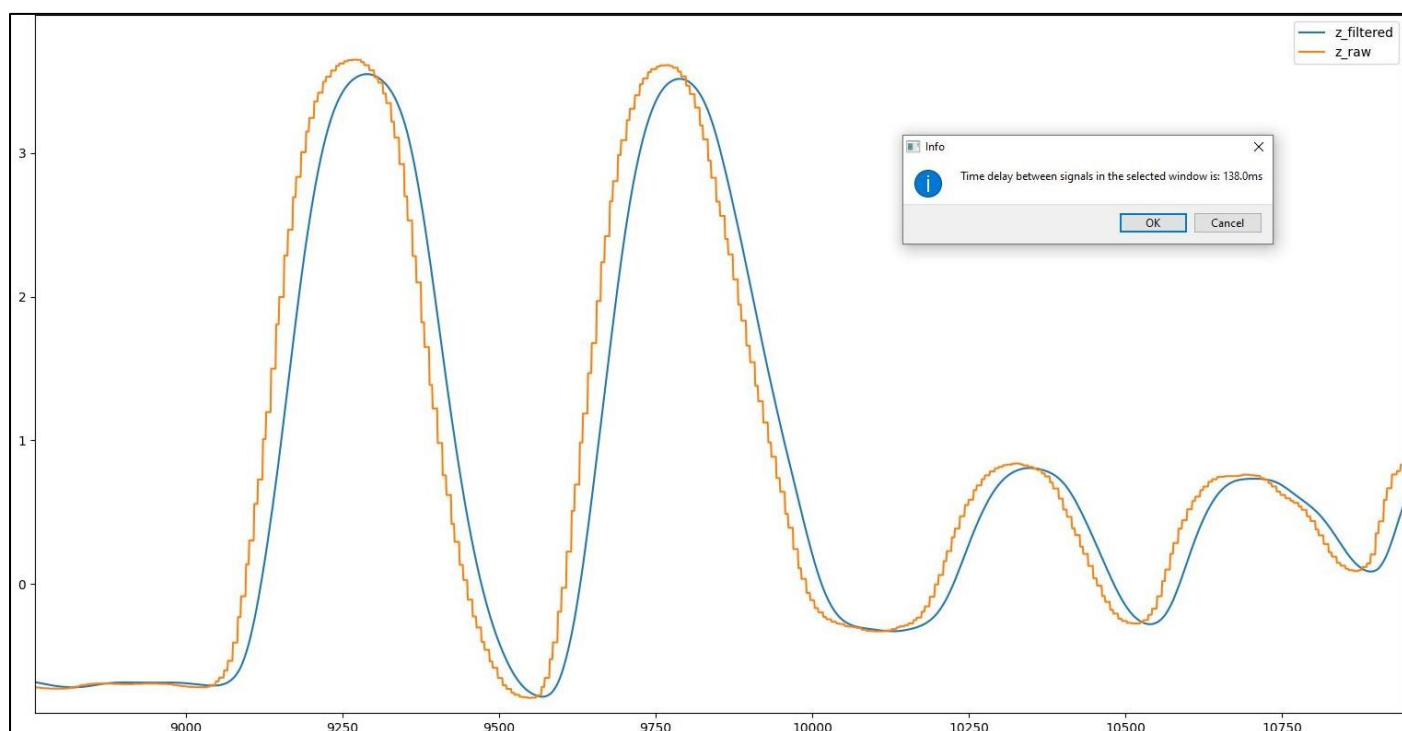
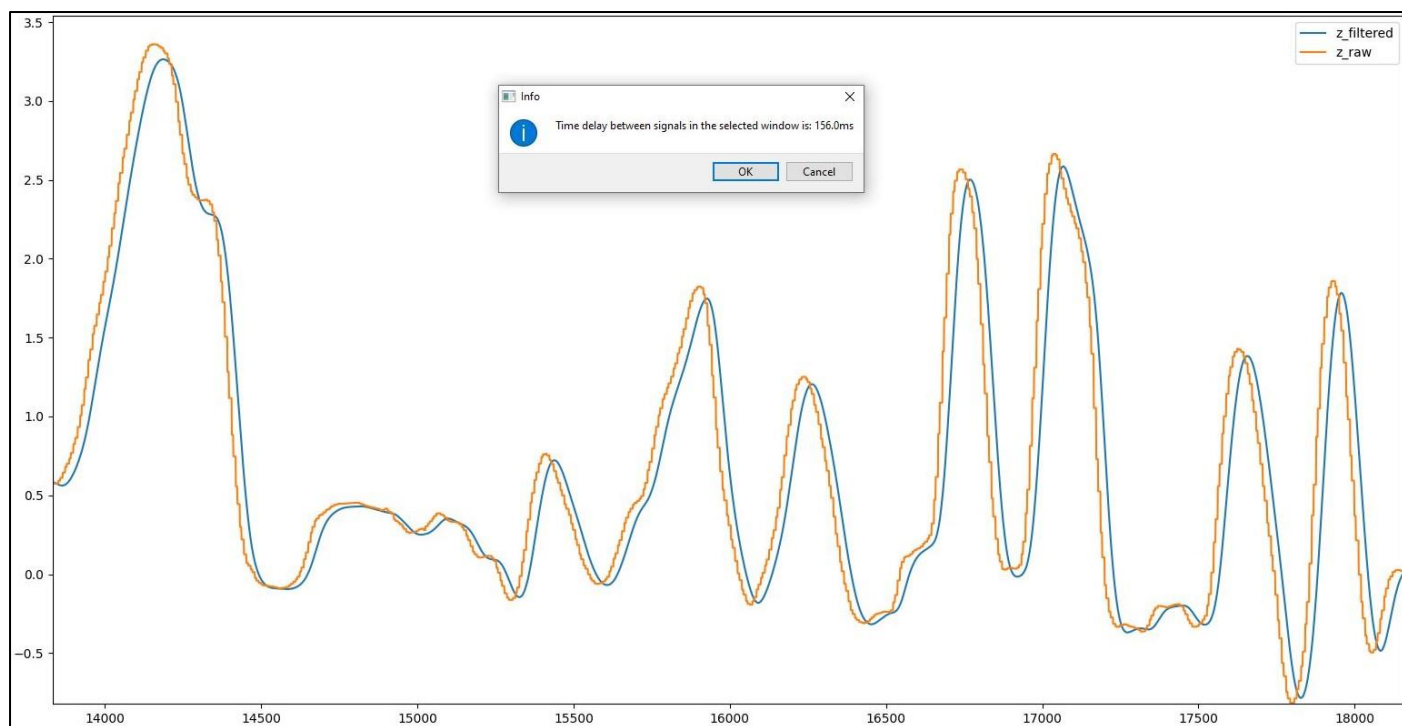
1. Delay measured in the filtered signal for hand tremor rejection using NDI tracking system is **more than 150 ms**.
2. Update rate of new pose data of hand controller obtained in RTOS varies from **20.83 Hz to 33.33 Hz**, whereas RTOS is running at approximately 166.67 Hz (6 ms).

Note: Only translation data was used in the below investigation.

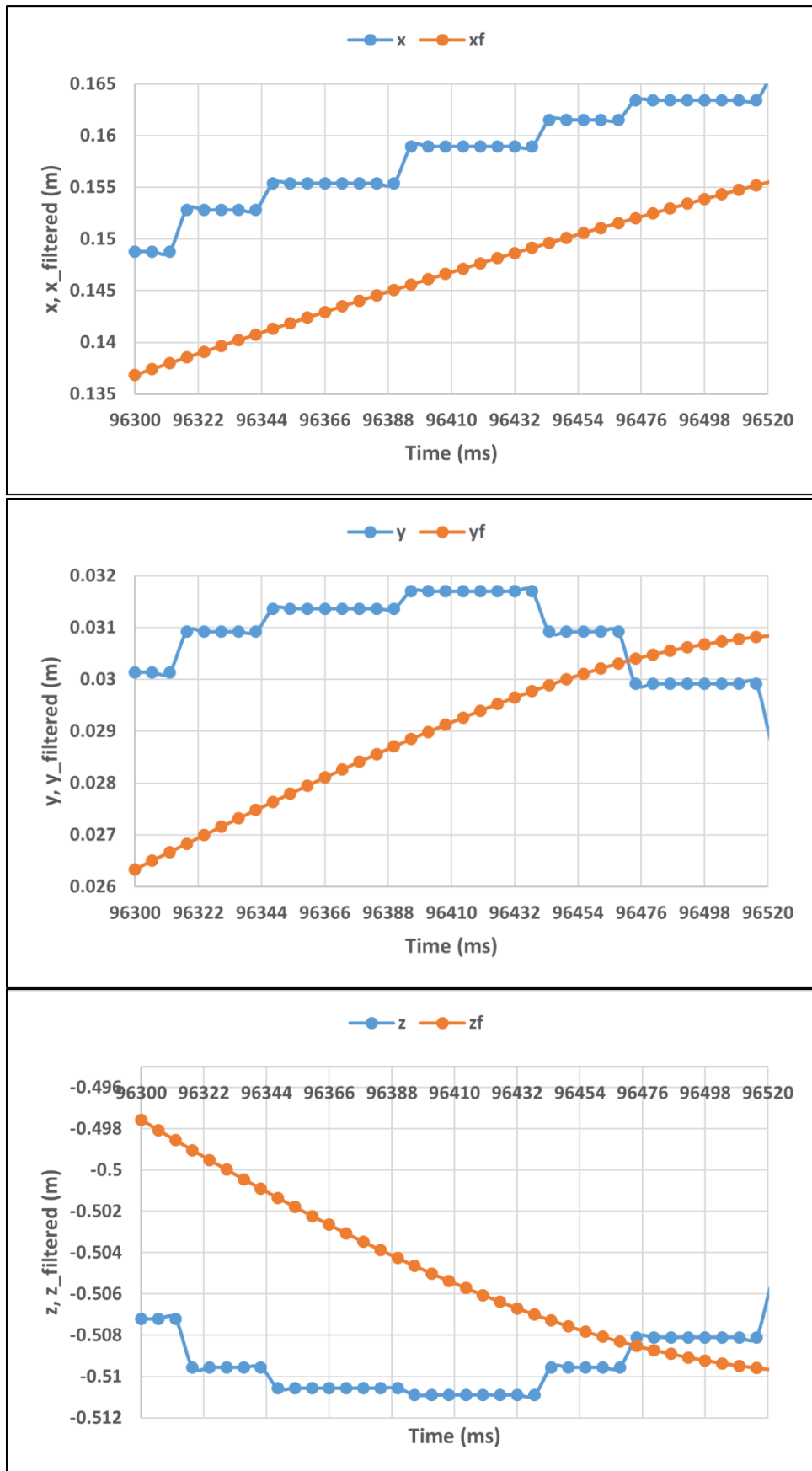
Measurement of delay in translation pose data after due to filter are as follows:







Update rate of sensor data is lower than the update rate of RTOS cycle time is indicated in figure below:



Case 1: Only electromagnetic sensor data is taken code for com port data communication and socket data communication are disabled.

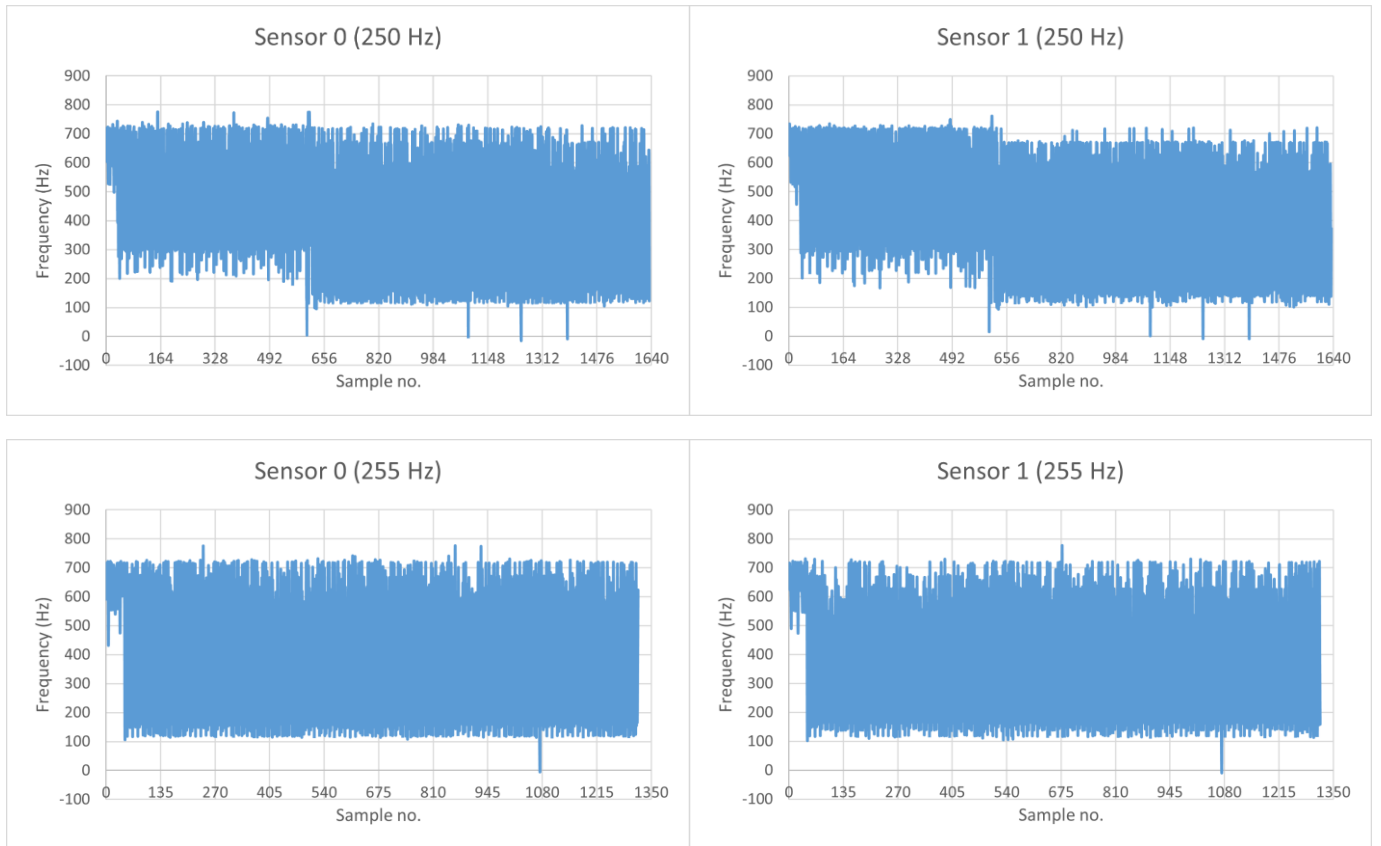
Setting measurement rate at different frequency

Test no.	Set rate (Hz)	Get rate (Hz)	Observation (console output)	Observed rate (Hz)					
				Sensor_0			Sensor_1		
				Mean	Min	Max	Mean	Min	Max
1	19	NA	set measurement rate = 19.000000 System : Size of parameter passed is incorrect Bird System Init Fail ATC3DG Application	NA	NA	NA	NA	NA	NA
2	20	20	get measurement rate=20.000000	409	116	779	391	109	762
3	25	25	get measurement rate=25.000000	398	0.49	777	374	0.49	763
4	50	50	get measurement rate=50.000000	397	0.59	828	375	0.59	772
5	100	100	get measurement rate=100.000000	391	0.27	801	372	0.27	775
6	150	150	get measurement rate=150.000000	384	0.36	799	365	0.36	747
7	200	200	get measurement rate=200.000000	383	0.32	783	366	0.32	738
8	250	250	get measurement rate=250.000000	429	0.32	776	418	0.32	761
9	255	255	get measurement rate=255.000000	395	2.02	773	374	2.02	774
10	256	NA	set measurement rate = 256.000000 System : Size of parameter passed is incorrect Bird System Init Fail	NA	NA	NA	NA	NA	NA

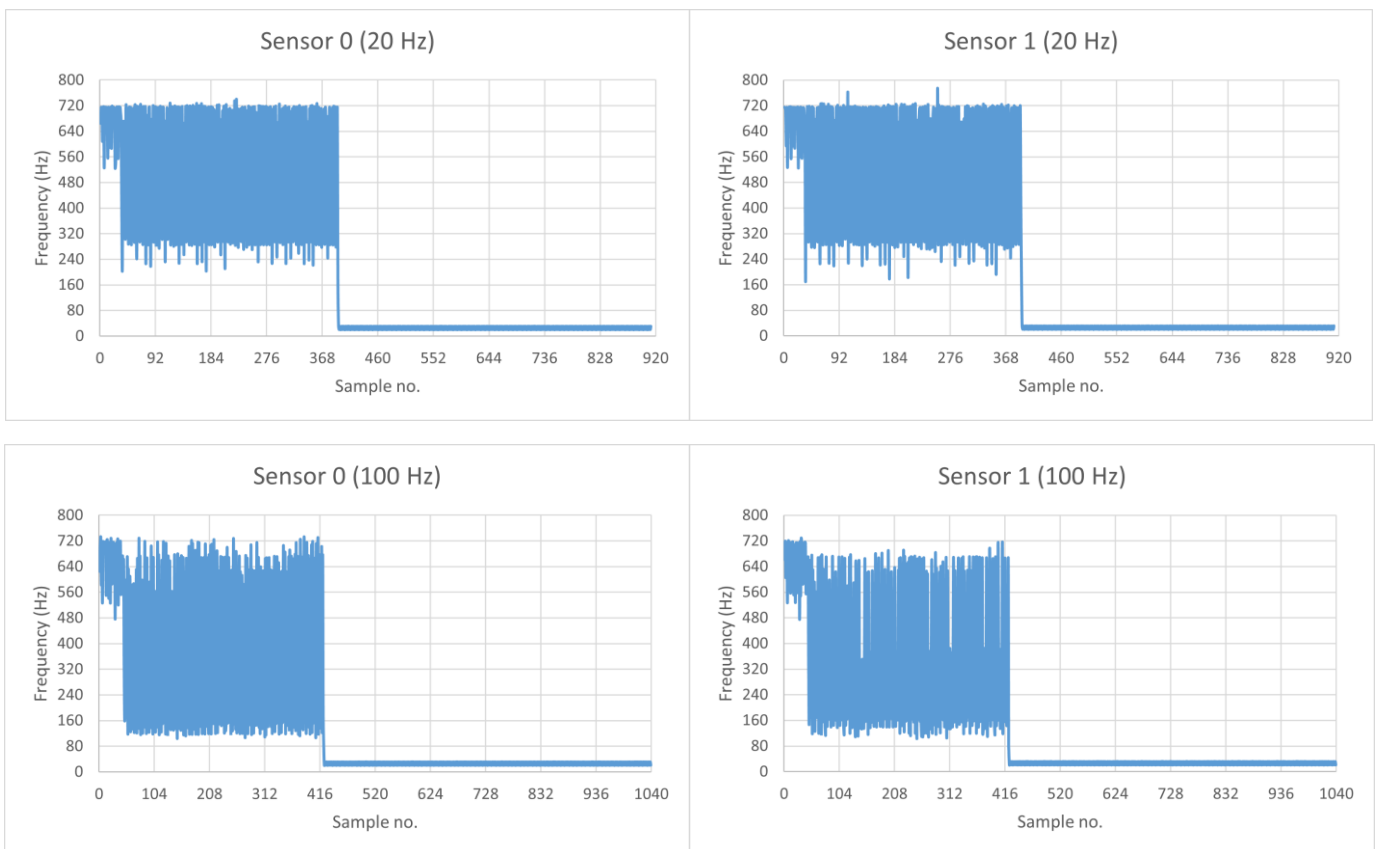
For evidence, below figure represents variation in loop frequency of measurement corresponding to statistical data in above table

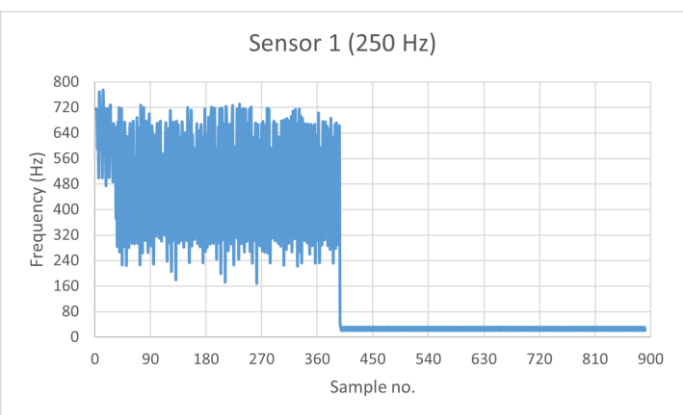
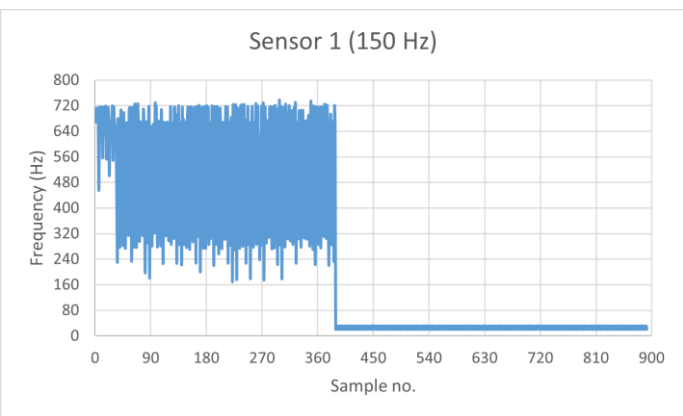






Case 2: Both electromagnetic sensor and serial data from IO-board is taken, code for socket data communication is disabled. Variation in loop frequency with sample number (loop count). After some time, the loop frequency drops down to 20 Hz.

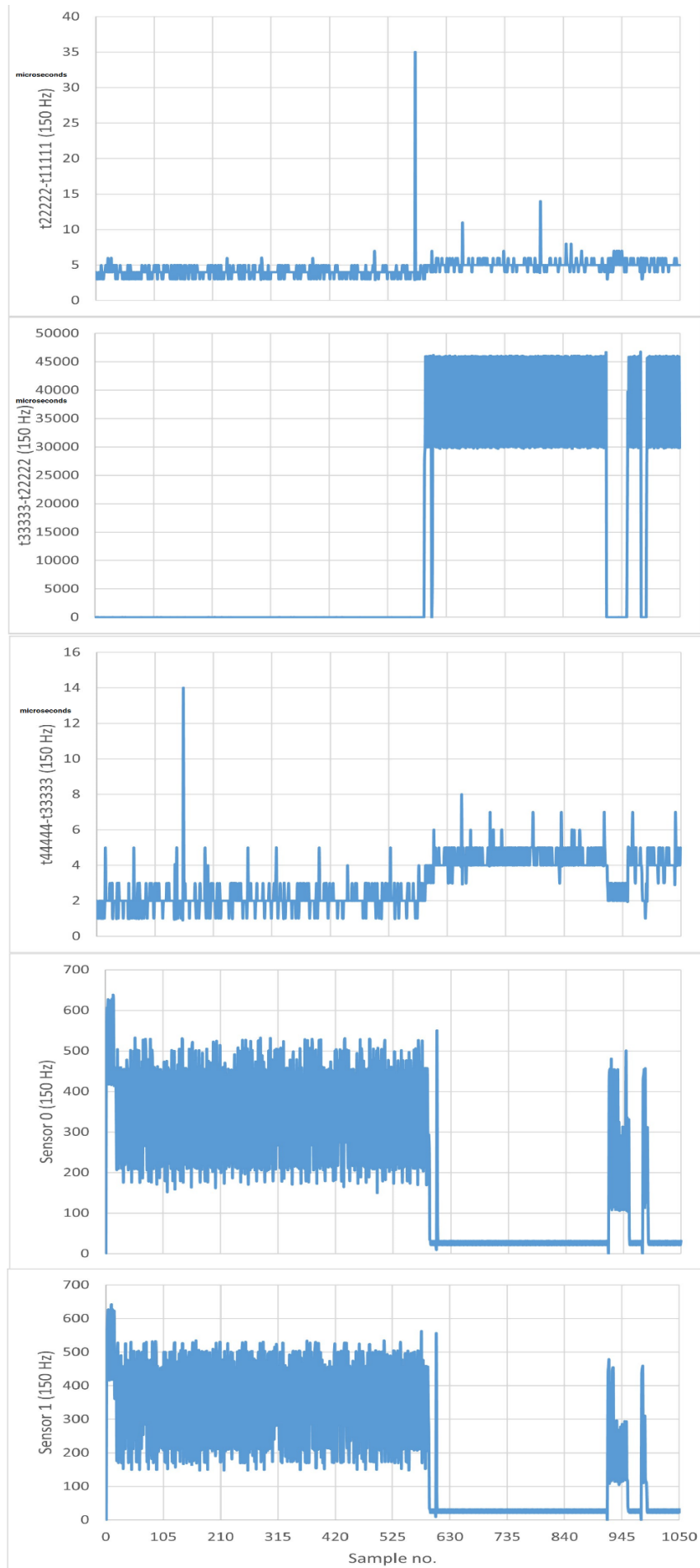




```

NDIComData.cpp = x [Global Scope]
563 //Sleep(delay_secs * 1000); // Windows Sleep is in milliseconds
564 //else
565 //    sleep(delay_secs); // Unix sleep is seconds
566 //endif
567 }
568 }
569 else {
570     /*std::time_t t = std::time(0);
571     std::cout << "Current time : " << t<<"\n"/
572     // Reading Serial Data - start
573     long long t11111 = get_t_now_us();
574     int n = ReadFile(sCom, szBuffer, sizeof(szBuffer), &dwRead, &ovr);
575     long long t22222 = get_t_now_us();
576     // Wait for the receive to complete and display the response
577     if (GetOverlappedResult(sCom, &ovr, &dwRead, TRUE))
578     {
579         //szBuffer[dwRead] = 0;
580         //printf("\n%s:szBuffer: %s\n", szBuffer);
581     }
582     long long t33333 = get_t_now_us();
583     //printf("\n%ld: Bytes Read = %d", dwRead);
584
585     std::string buff;
586     std::string msg;
587     for (let i = 0; i < dwRead; i++)
588     {
589         //std::cout << "for test file : %0x\n";
590         //std::cout << "for test file : %0x\n";
591         if (i == 0) // Start Byte
592         {
593             sData.comData.startByte = szBuffer[i]; // Start Byte 0th - 0x5A
594             //printf("Start Byte : %X\n", szBuffer[i]);
595
596             buff = dectohex(szBuffer[i]);
597             if (buff.empty())
598                 buff = "00";
599             msg = "Start byte : " + buff;
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Drop in loop frequency of data acquisition from NDI sensors after the serial communication initiates.



Solutions

1. Time for execution of program in loop should be controlled according to the update rate of data from NDI sensor and IO board or Serial communication and NDI sensor data acquisition + data transmission using socket should run in two separate threads. **(It will reduce the delay by a minimum of 24 ms to 42 ms).**
2. Redesign of filter for tremor rejection. **(It will reduce the delay by a minimum of 100 ms)**