Arterial Vascular Impedance Calculation

AIM: To calculate Arterial Vascular Impedance, $\boldsymbol{Z(j\Omega)} = \frac{\boldsymbol{P(j\Omega)}}{\boldsymbol{Q(j\Omega)}}$, where ***P*** is intra-arterial pressure (in mmHg) and ***Q*** is blood volume-flow (in ml/s).

Currently, the data (1,2,3) can be collected simultaneously using CMCdaq without any time- synchronization issue.

STEP1: The following are the data collected simultaneously:

1. Intra-arterial pressure (***p[n]***) at 4 KHz.
2. Video recorded at 30fps.
3. Audio recorded at 4KHz

$\Longrightarrow$ From Ultrasound Machine

STEP2: Conversion to frequency domain:

2.1. ***p[n]*** → **DFT** → ***P(jΩ)*** **, N= 4000 samples/s.**

2.2. Calculation of volume-flow: *q[n]*

2.2.1. Frame-wise area calculation: ***a[n], n= frame no***.

2.2.2. For one frame duration, no: of audio samples = 4000/30 = 133 samples/frame: ***x[n], N=133***

2.2.3. ***x[n]*** → **DFT** → ***X(jΩ)*** → ***Averaging*** = average doppler shifted freq (f_D) → conversion to average velocity, ***v[n]***, using, $\mathbf{f_D} = \frac{\boldsymbol{2 . f . v \cos \theta}}{\boldsymbol{c}}$, f is the probe txn freq=11MHz, c is velocity of soud in blood=1580 m/s, $\theta = 60^o$.

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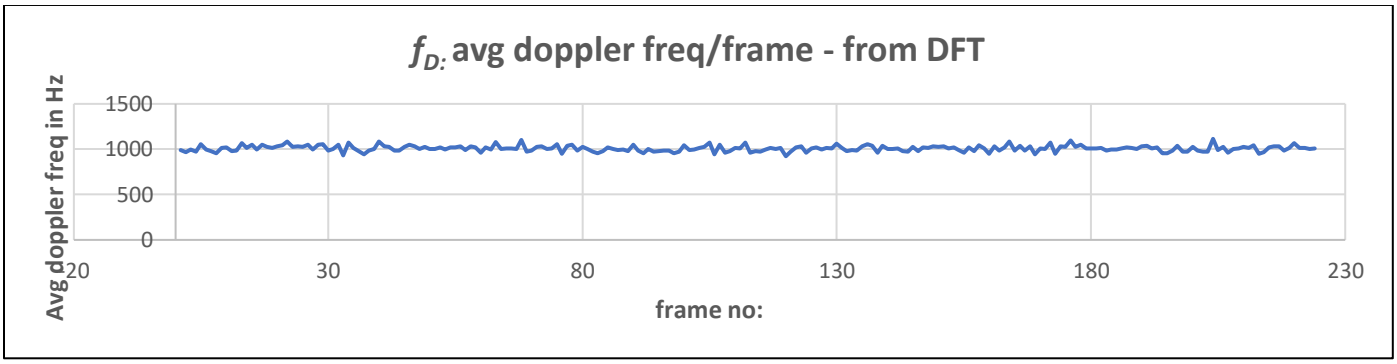
2.2.4. Hence, calculation of volume flow, ***q[n]= a[n] . v[n]***

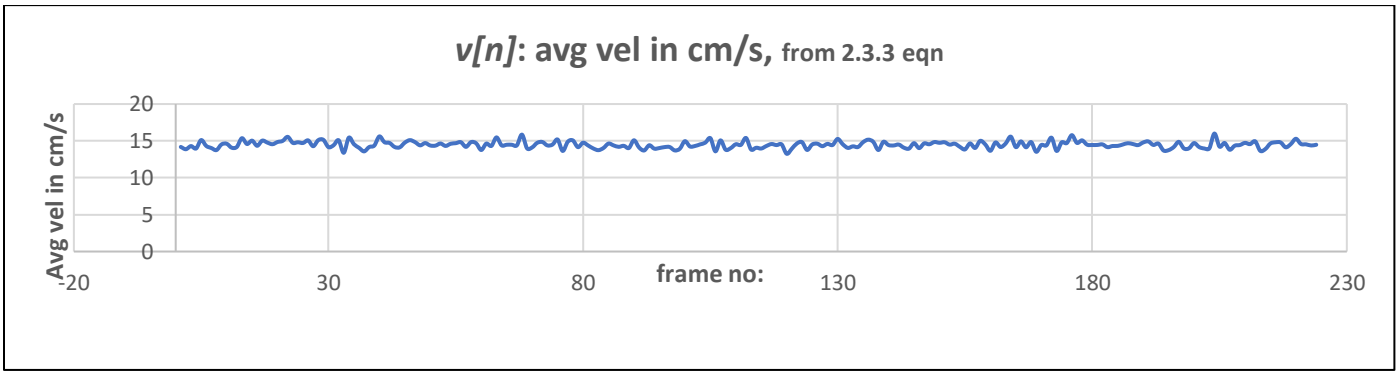
2.3. Conversion of q[n] to frequency domain:

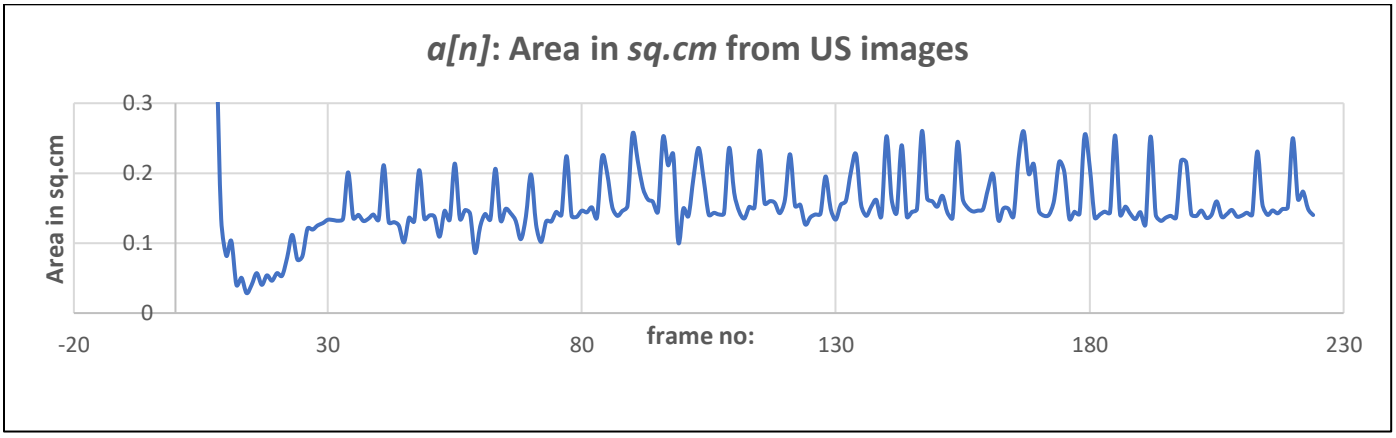
q[n] → **DFT** → ***Q(jΩ)*** → ***Zero padding to 4000 samples*** → **IDFT** → ***q[n], N=4000***

2.4. Arterial Vascular Impedance, $\boldsymbol{Z(j\Omega)} = \frac{\boldsymbol{P(j\Omega)}}{\boldsymbol{Q(j\Omega)}}$

Summary of Calculations from Video (10fps) and audio (4KHz) collected simultaneously:







NB: Video was recorded at 10fps in CMCdaq. We need to standardize data-collection procedure (for stable angle & video).