barycenter linear predictor $\hat{v}(t_i) = \langle v \rangle_n^\bullet + \hat{a}_n \left(t_i - \langle t \rangle_n^\bullet\right)$

$\hat{a}_n$ is estimated from buffered data sample (past measures over N cycles including current sample) according to the least squares fitting method (i.e. by minimizing the sum of squared residuals) $\hat{v}_n = \langle v \rangle_n^\bullet$ is already the value minimizing the error

$$Q(\hat{v}_n, \hat{a}_n) = \sum_i e_i^2 = \sum_{i=n}^{n-N^\bullet+1} [v_i - \hat{v}(t_i)]^2 = \sum_{i=n}^{n-N^\bullet+1} [v_i - \langle v \rangle_n^\bullet - \hat{a}_n (t_i - \langle t \rangle_n^\bullet)]^2$$

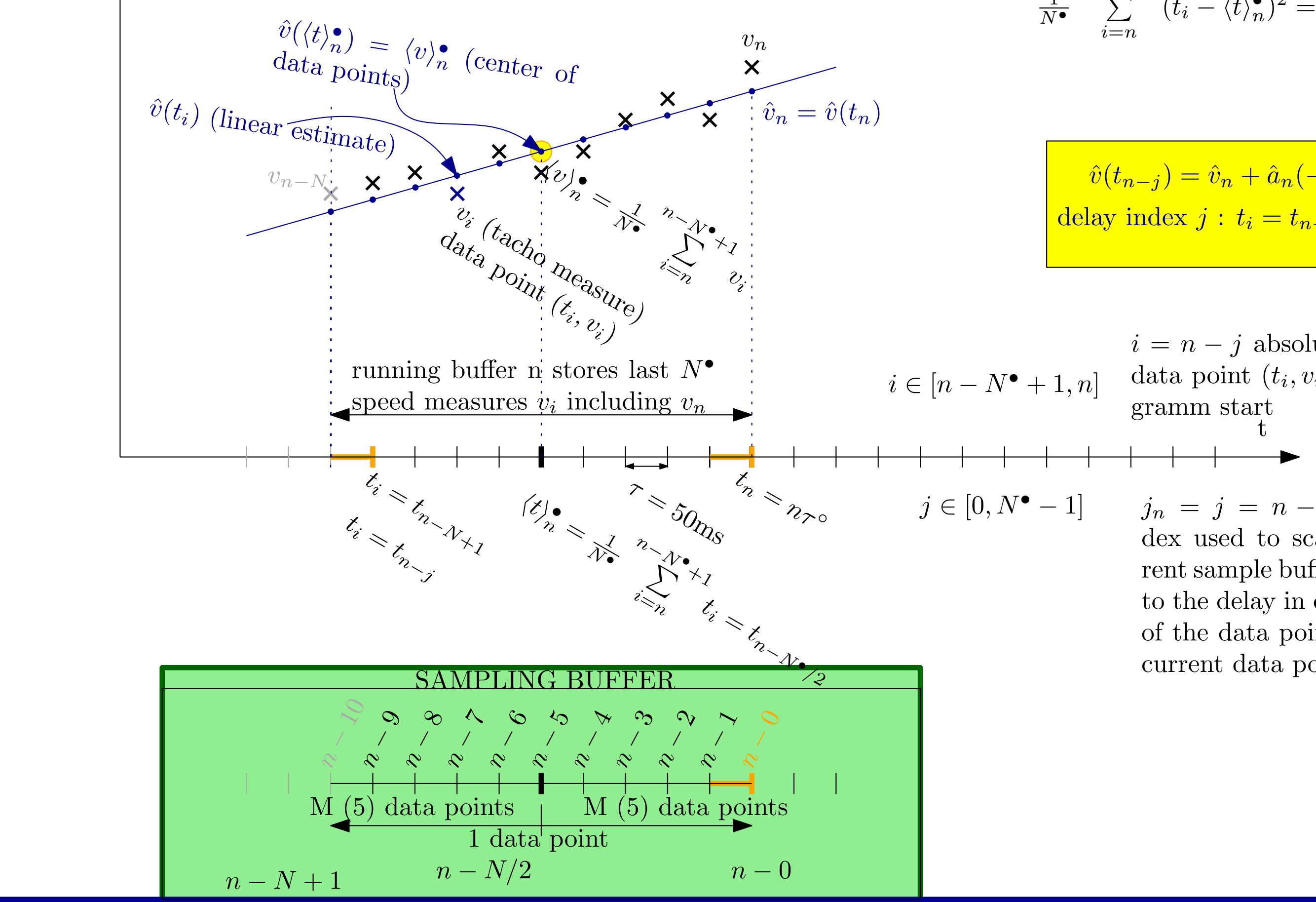
by setting the derivative to zero we obtain:

$$\begin{aligned}
\frac{\partial Q(\hat{v}_n, \hat{a}_n)}{\partial \hat{a}_n} &= \sum_{i=n}^{n-N^\bullet+1} -2[v_i - \langle v \rangle_n^\bullet - \hat{a}_n (t_i - \langle t \rangle_n^\bullet)](t_i - \langle t \rangle_n^\bullet) = 0 \\
\sum_{i=n}^{n-N^\bullet+1} (v_i - \langle v \rangle_n^\bullet)(t_i - \langle t \rangle_n^\bullet) &= \hat{a}_n \sum_{i=n}^{n-N^\bullet+1} (t_i - \langle t \rangle_n^\bullet)^2 \\
\hat{a}_n &= \frac{\frac{1}{N^\bullet} \sum_{i=n}^{n-N^\bullet+1} (v_i - \langle v \rangle_n^\bullet)(t_i - \langle t \rangle_n^\bullet)}{\frac{1}{N^\bullet} \sum_{i=n}^{n-N^\bullet+1} (t_i - \langle t \rangle_n^\bullet)^2}
\end{aligned}$$

last step was obtained by dividing by $N^\bullet$ and rearranging the terms:

$$\langle t \rangle_n^\bullet = \frac{1}{N^\bullet} \sum_{i=n}^{n-N^\bullet+1} t_i = t_{n-N^\bullet/2}$$

$$\frac{1}{N^\bullet} \sum_{i=n}^{n-N^\bullet+1} (t_i - \langle t \rangle_n^\bullet)^2 = \frac{(N-1)(N+1)}{12}$$



$\hat{v}(t_{n-j}) = \hat{v}_n + \hat{a}_n(-j\tau)$

delay index j : $t_i = t_{n-j} = t_n - j\tau$

$i \in [n - N^\bullet + 1, n]$

$i = n - j$ absolute index of data point (t_i, v_i) from programm start

$j \in [0, N^\bullet - 1]$

$j_n = j = n - i$ delay index used to scan the current sample buffer referring to the delay in cycles $j \geq 0$ of the data point from the current data point (t_n, v_n)