MBHA001 – Spikes Investigation - on the time varying inductance

M. Martino (CERN)

Thanks to: MBHA001 – Spikes Investigation “Team”

3 April 2020

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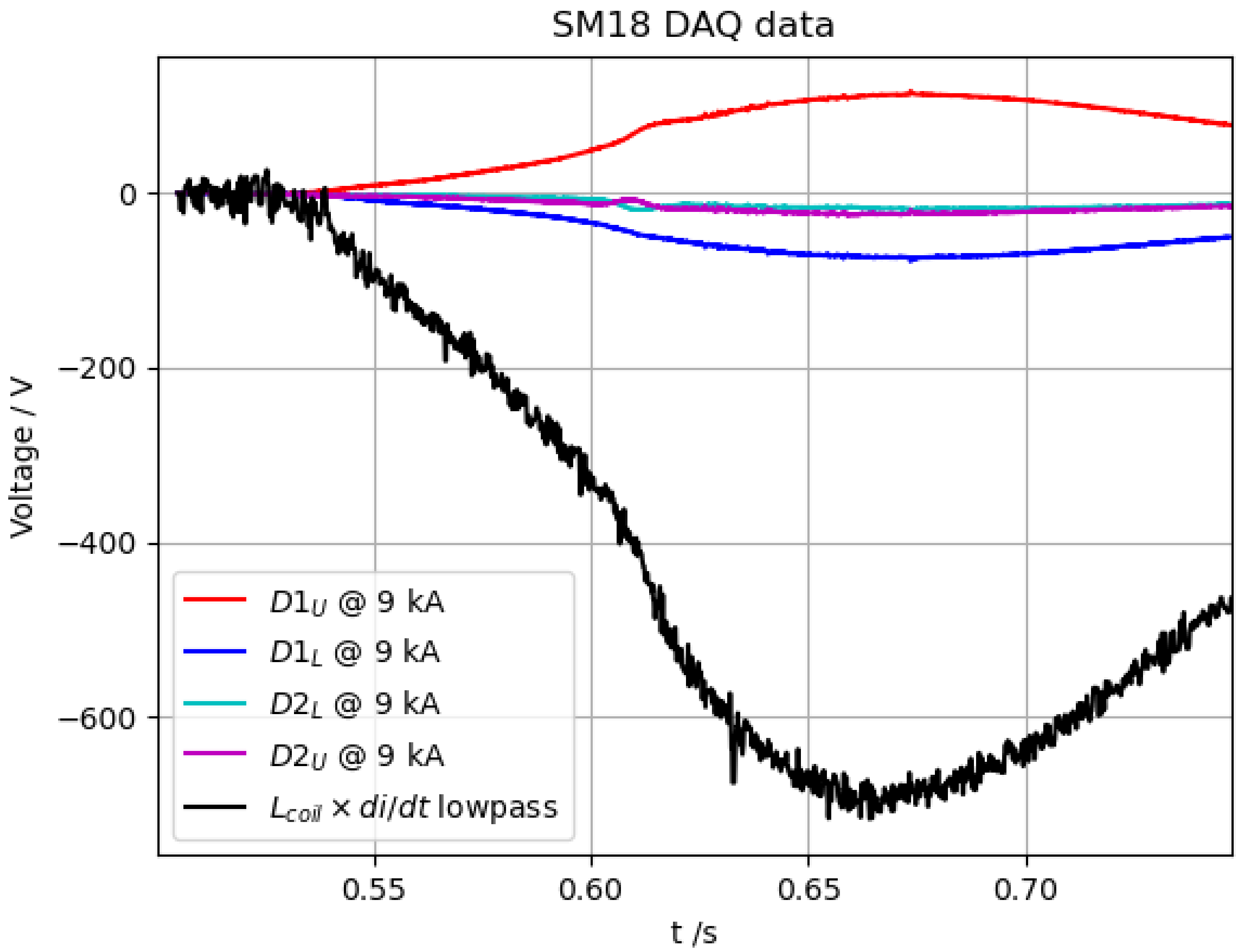

Current from “noisy” SM18 DAQ

Butterworth 6[th] order

2500 Hz everywhere

+

Medianfilter 51 points here

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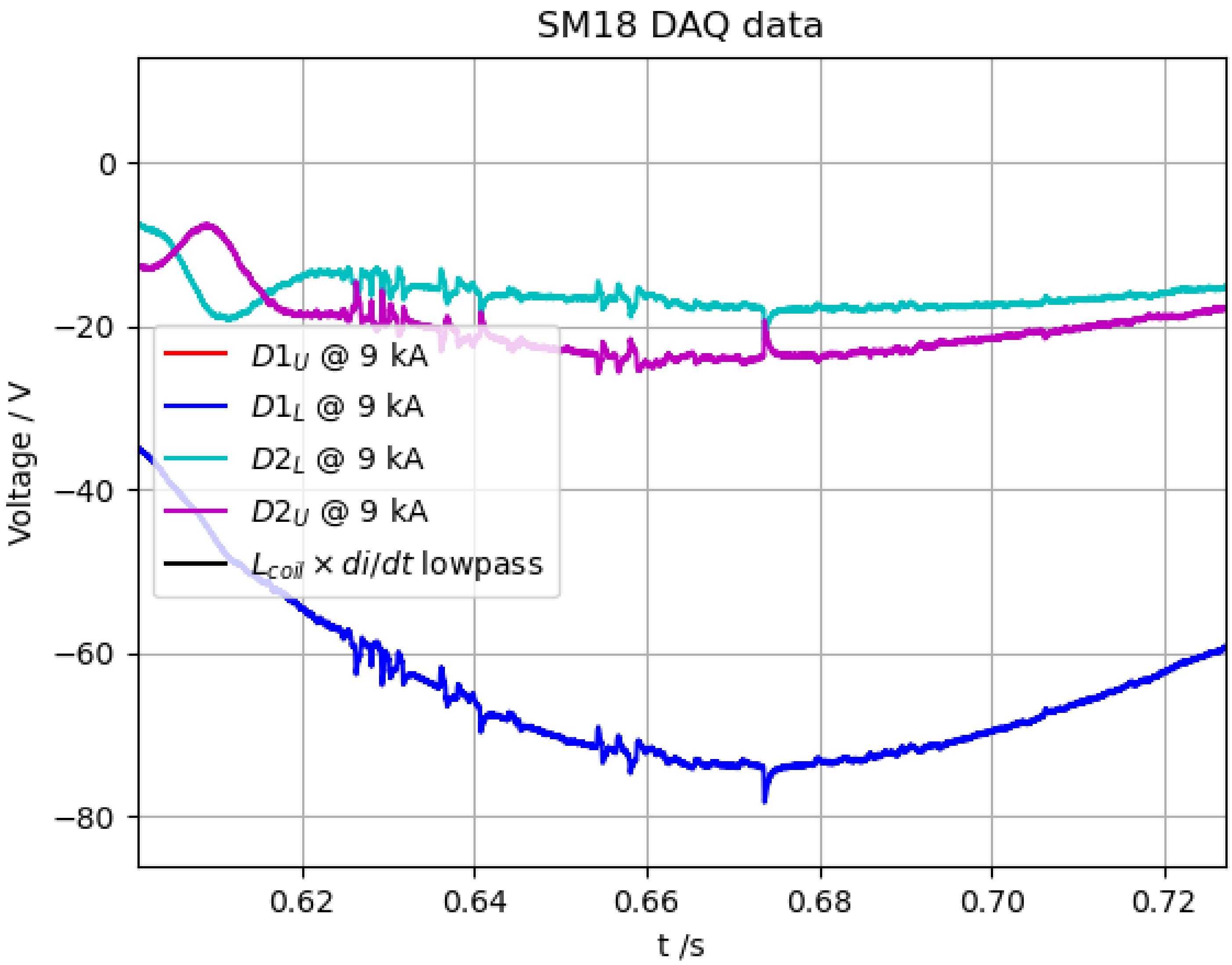

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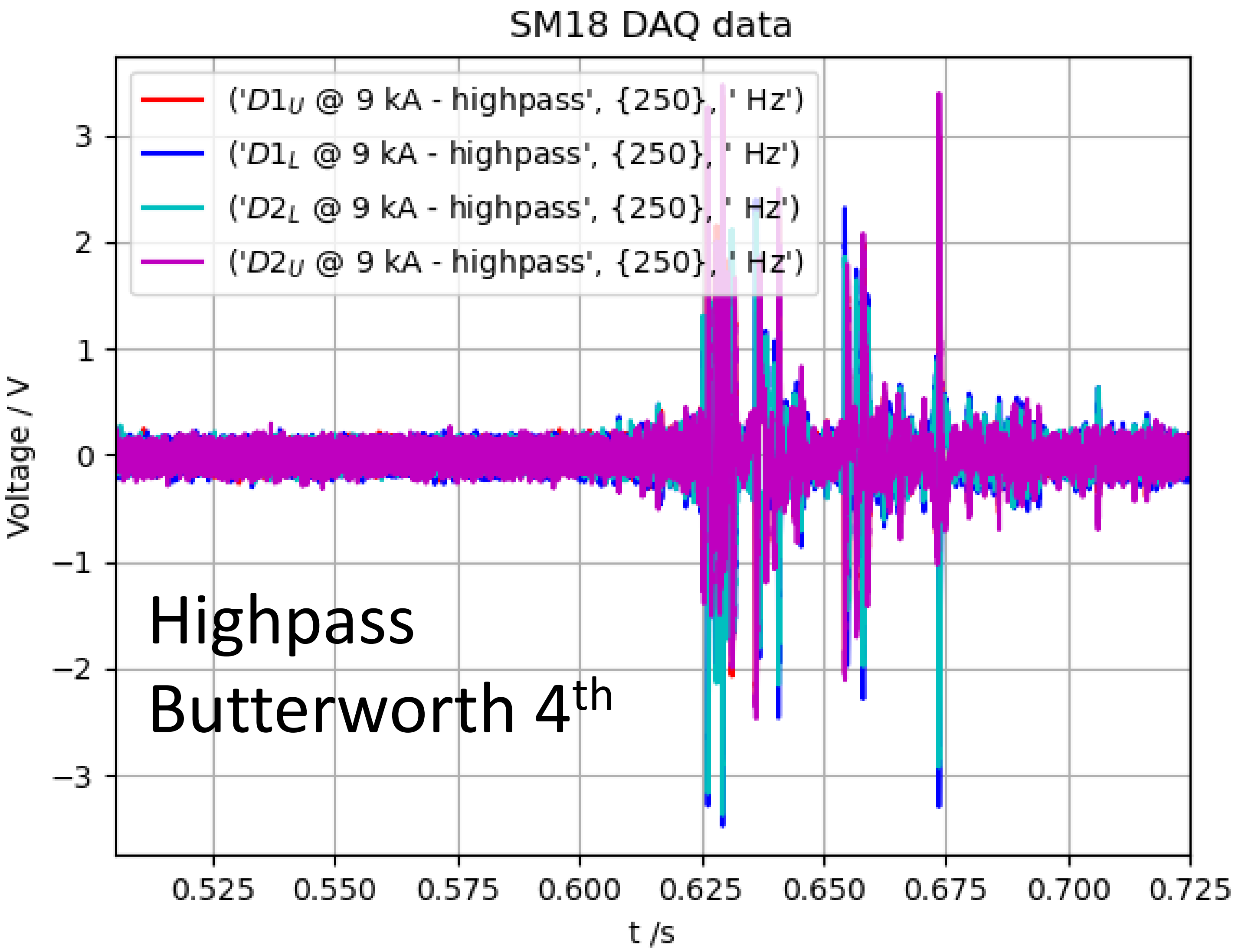

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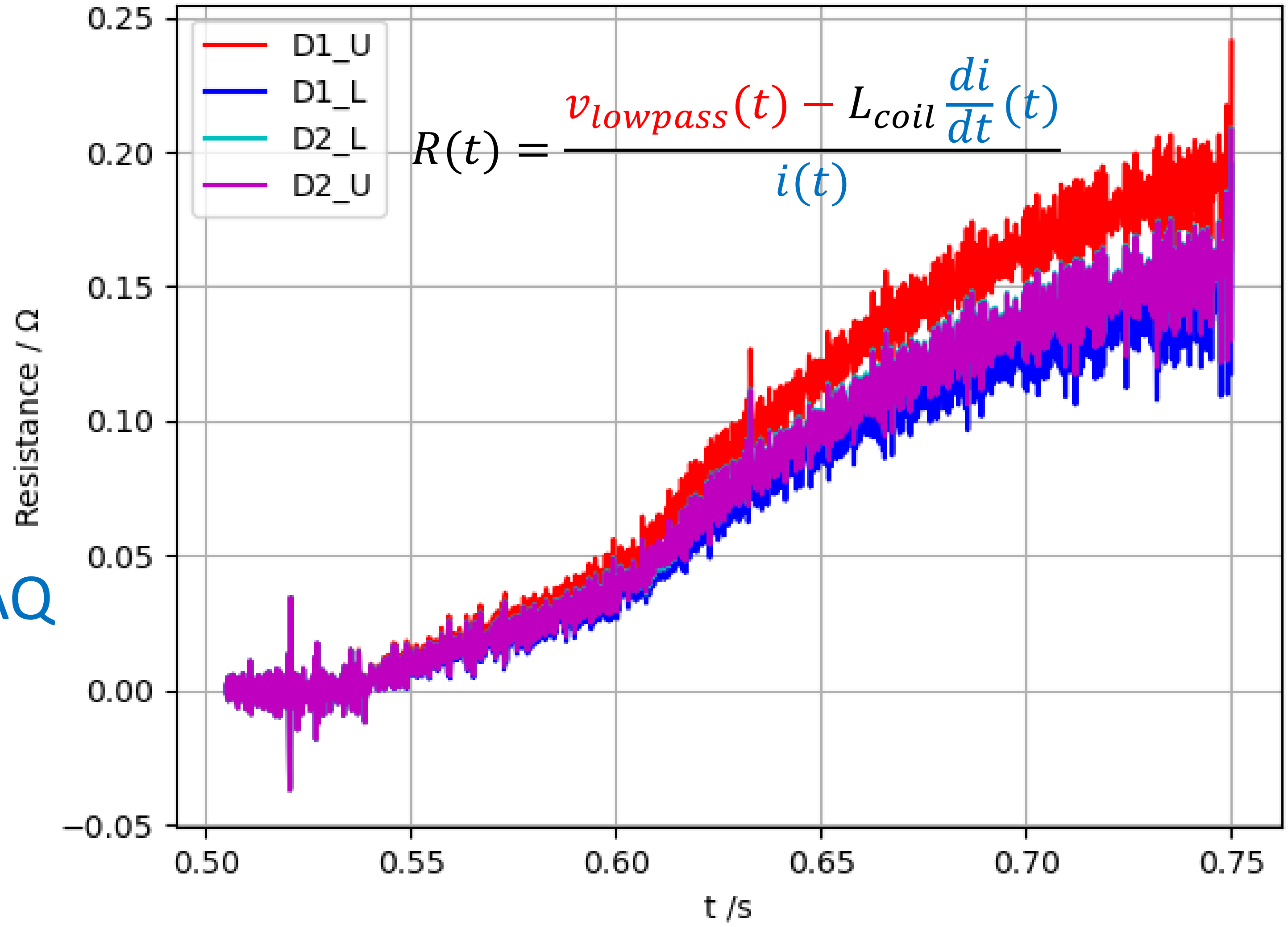
Lowpass 250 Hz
Butterworth 4th

Current from
"noisy" SM18 DAQ
Butterworth 6th
order 2500 Hz



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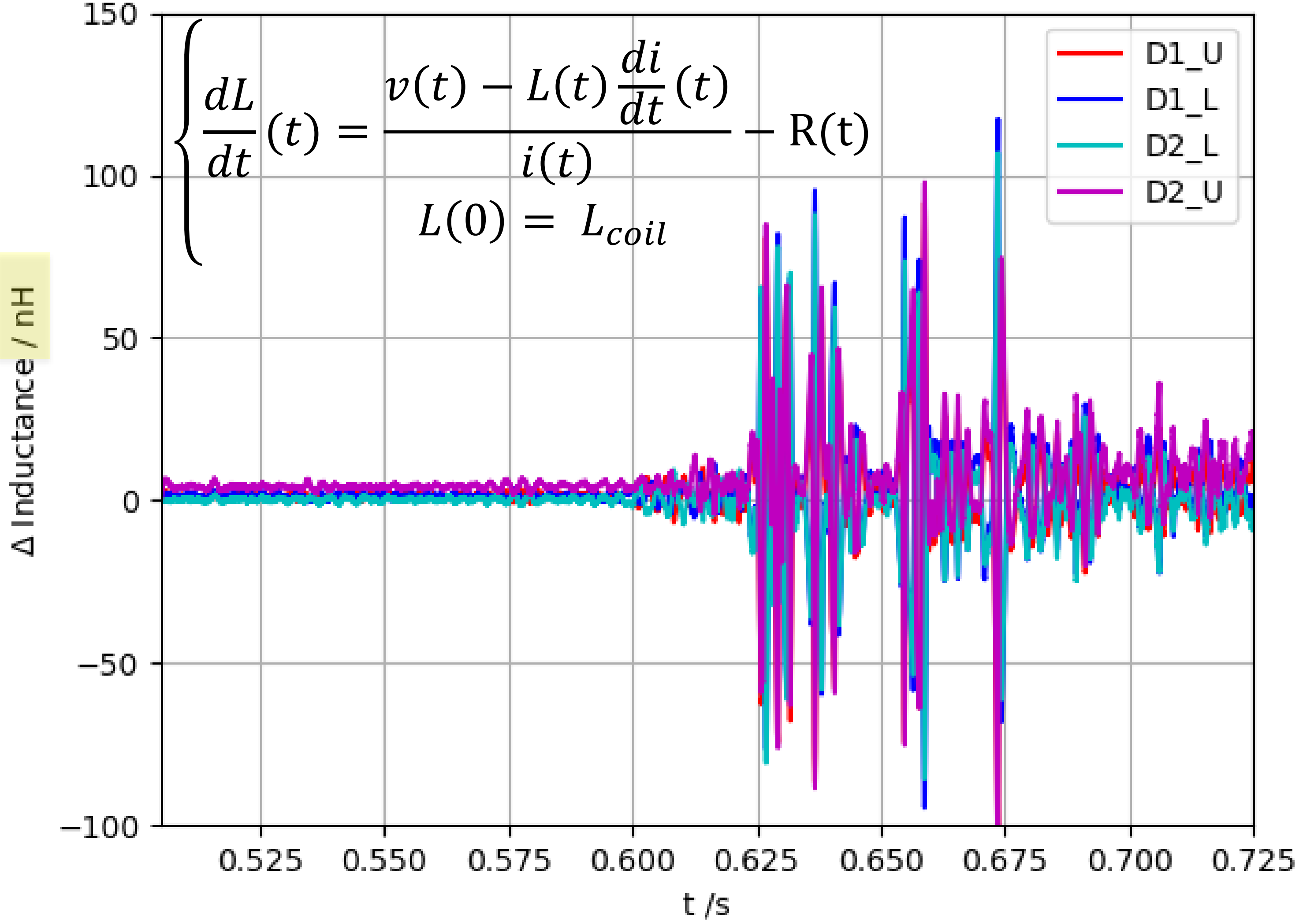

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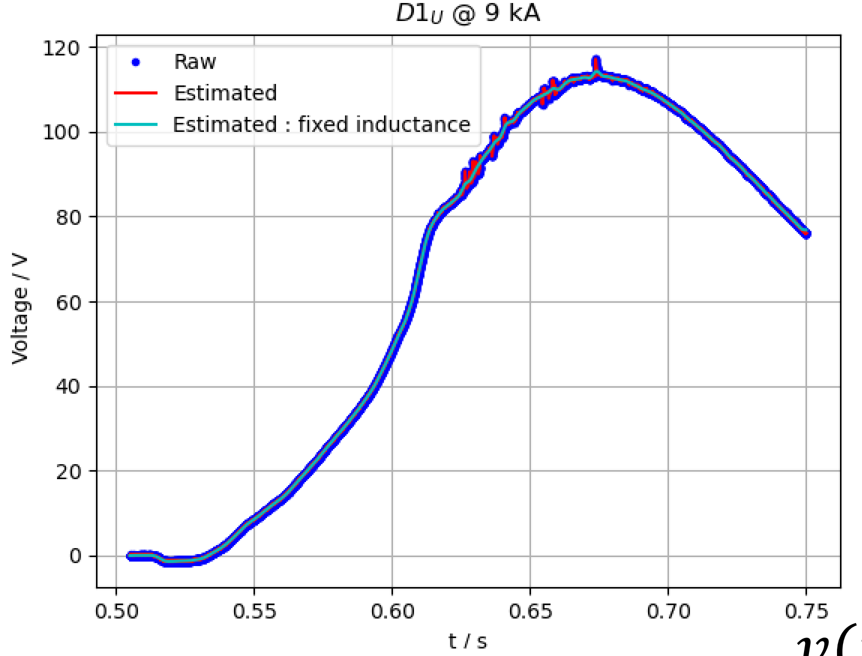
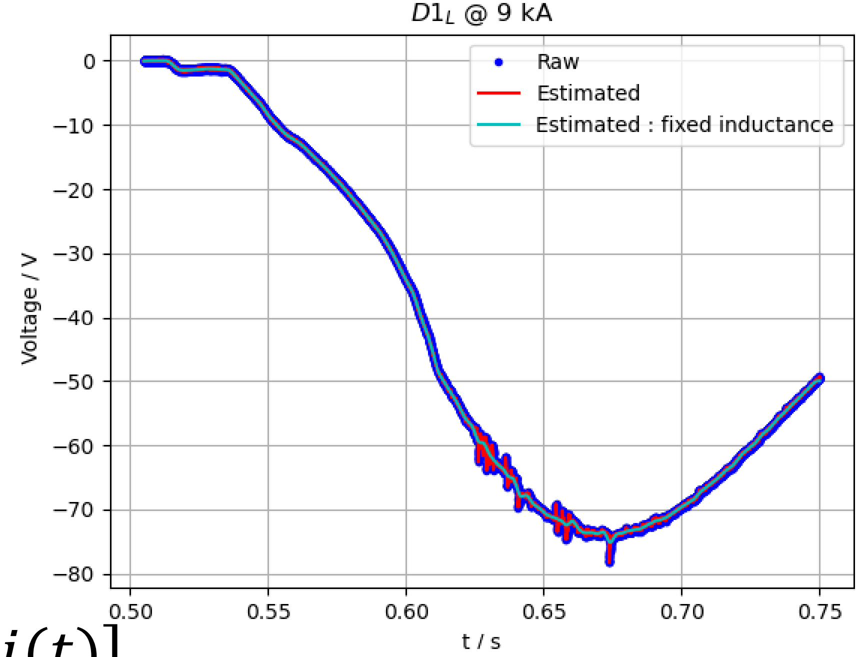
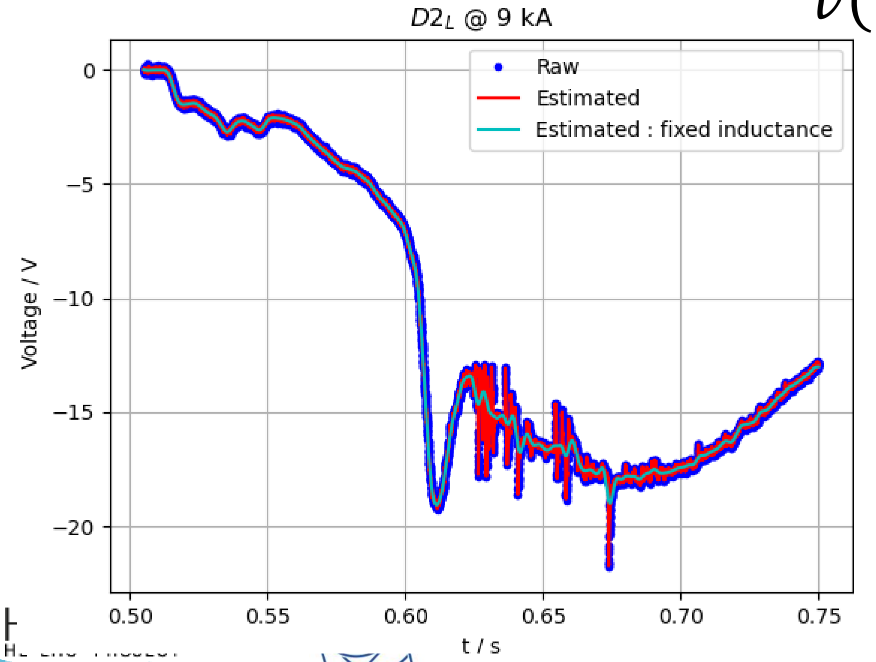
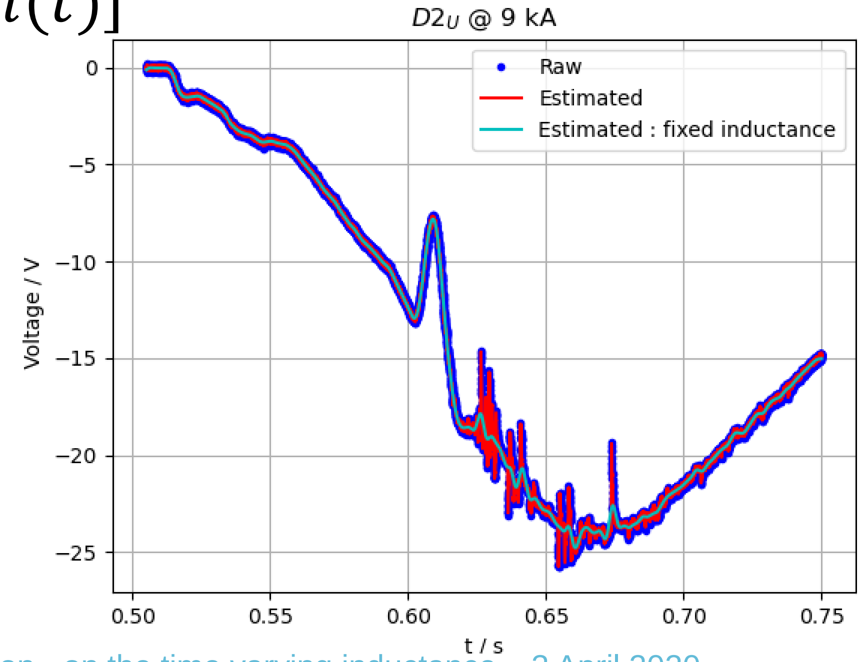




$$v(t) = R(t) + \frac{d}{dt}[L(t)i(t)]$$





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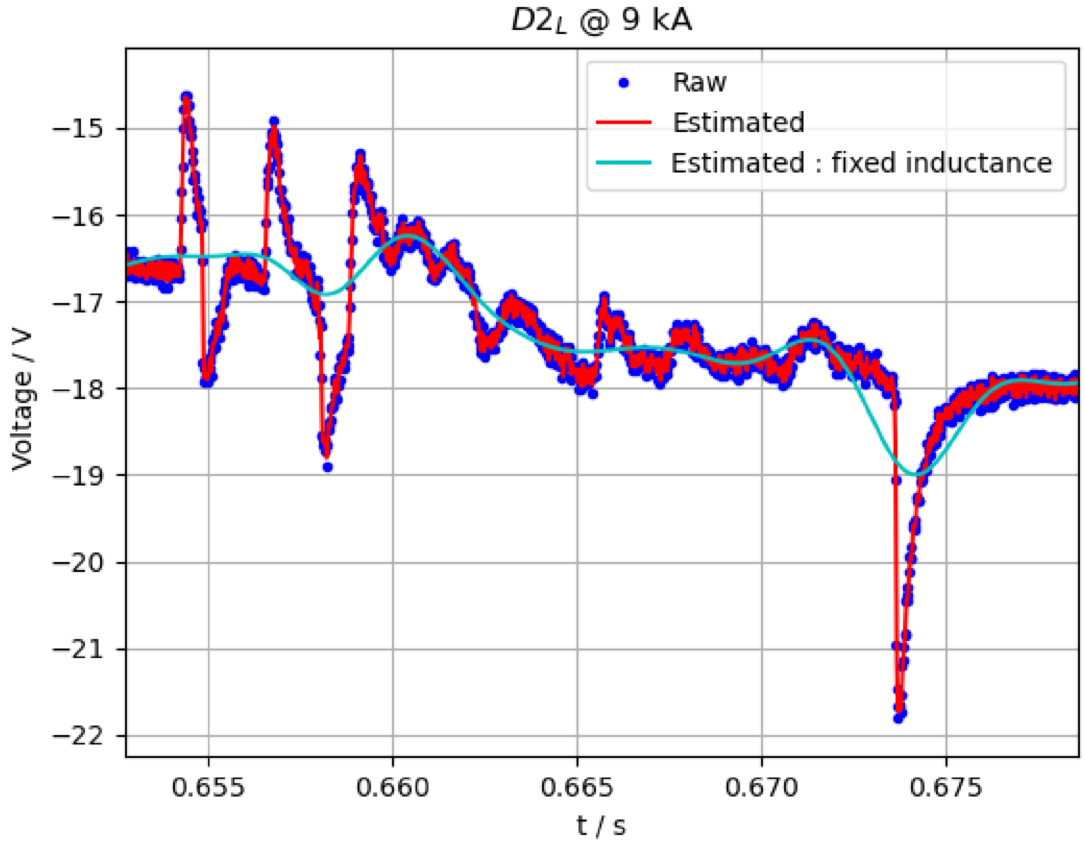

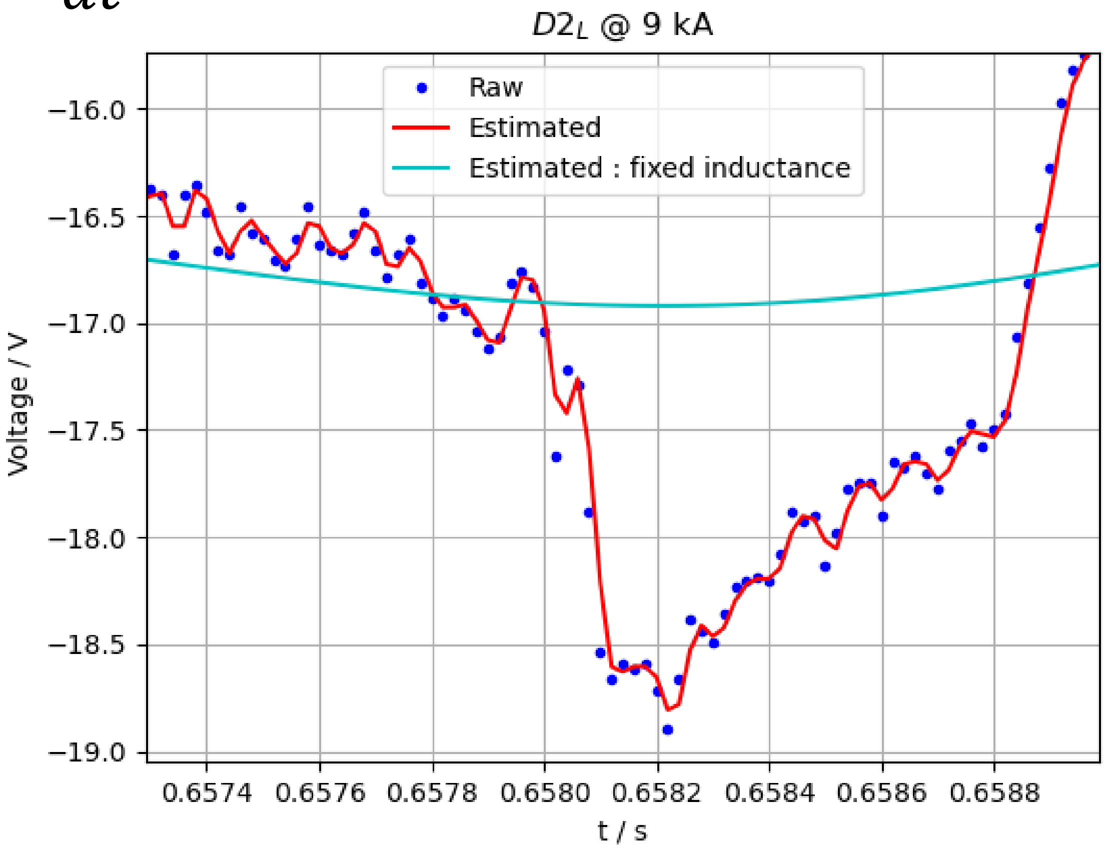

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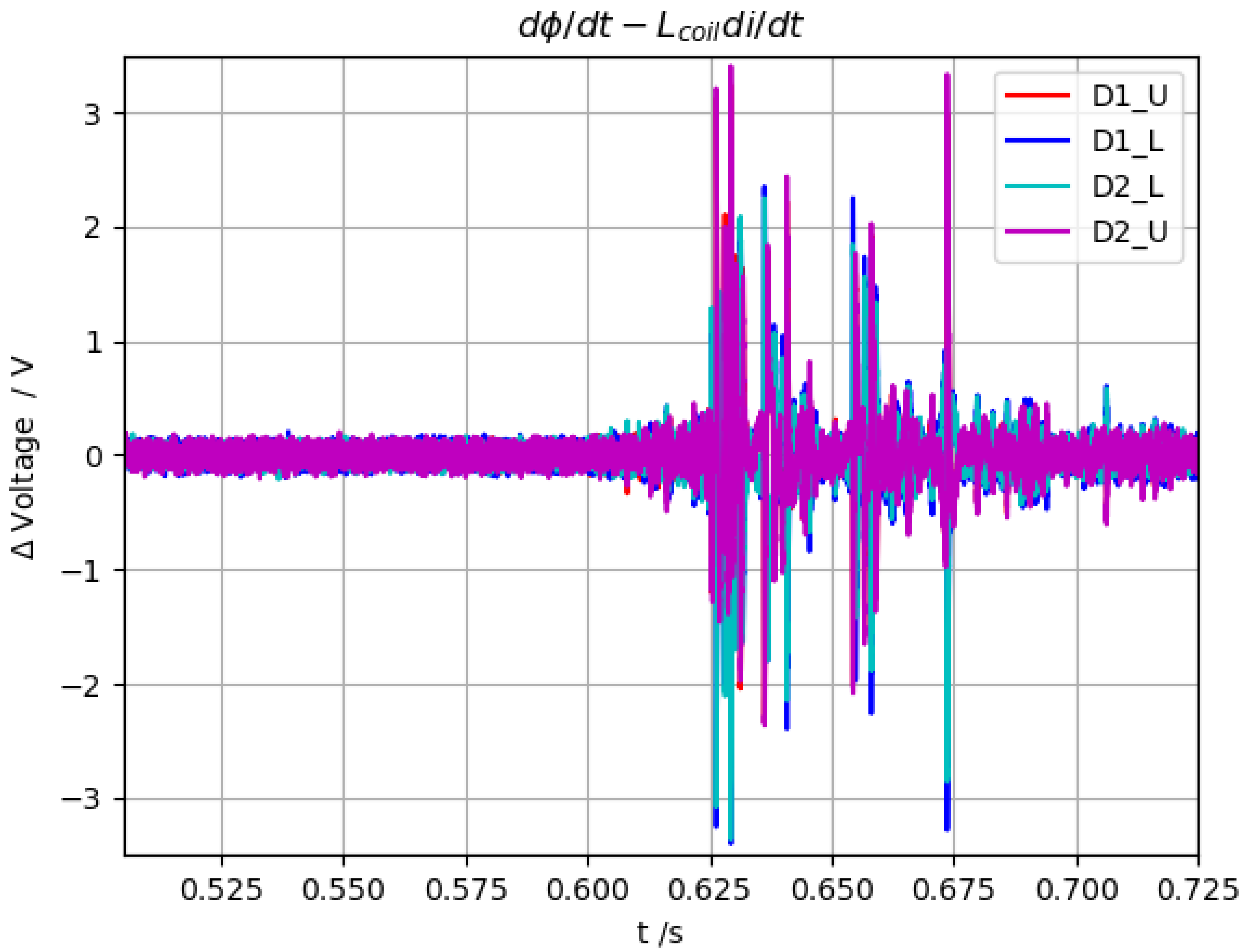

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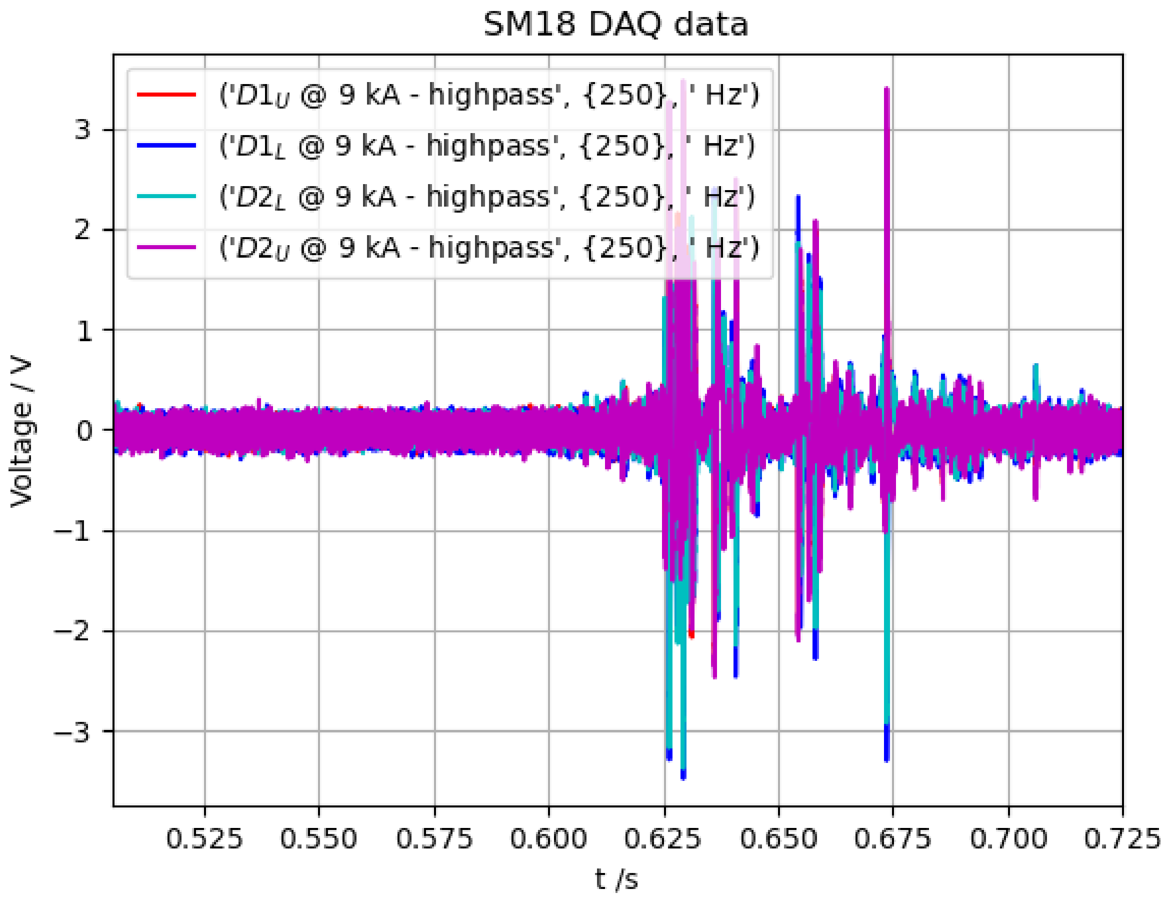

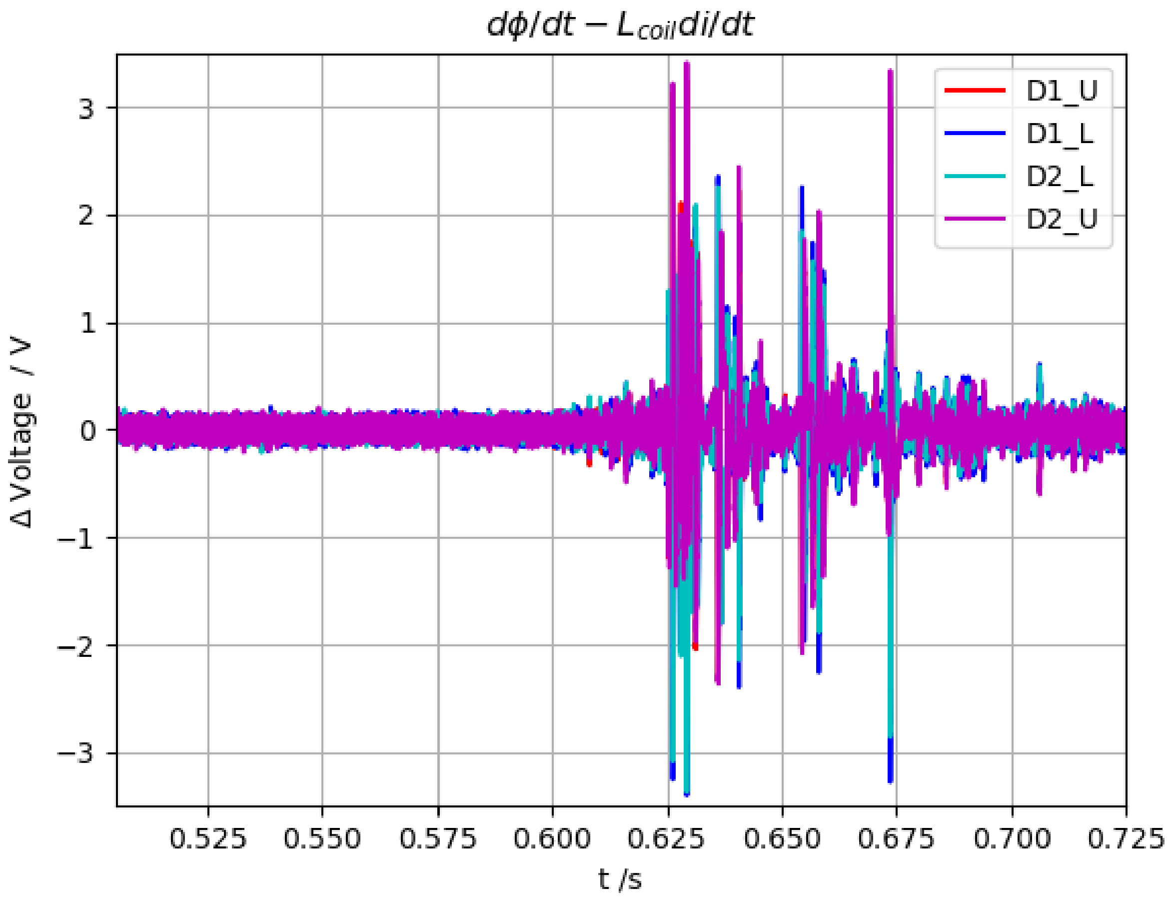

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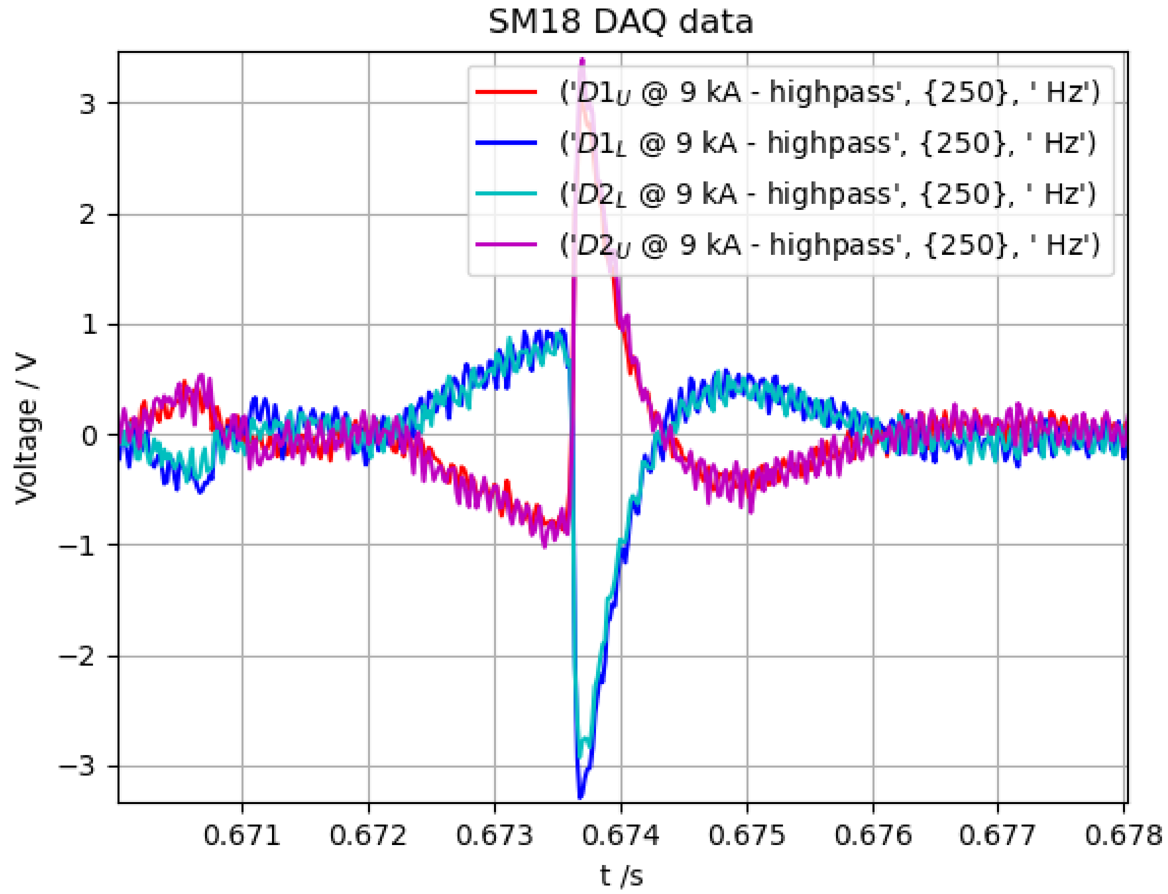

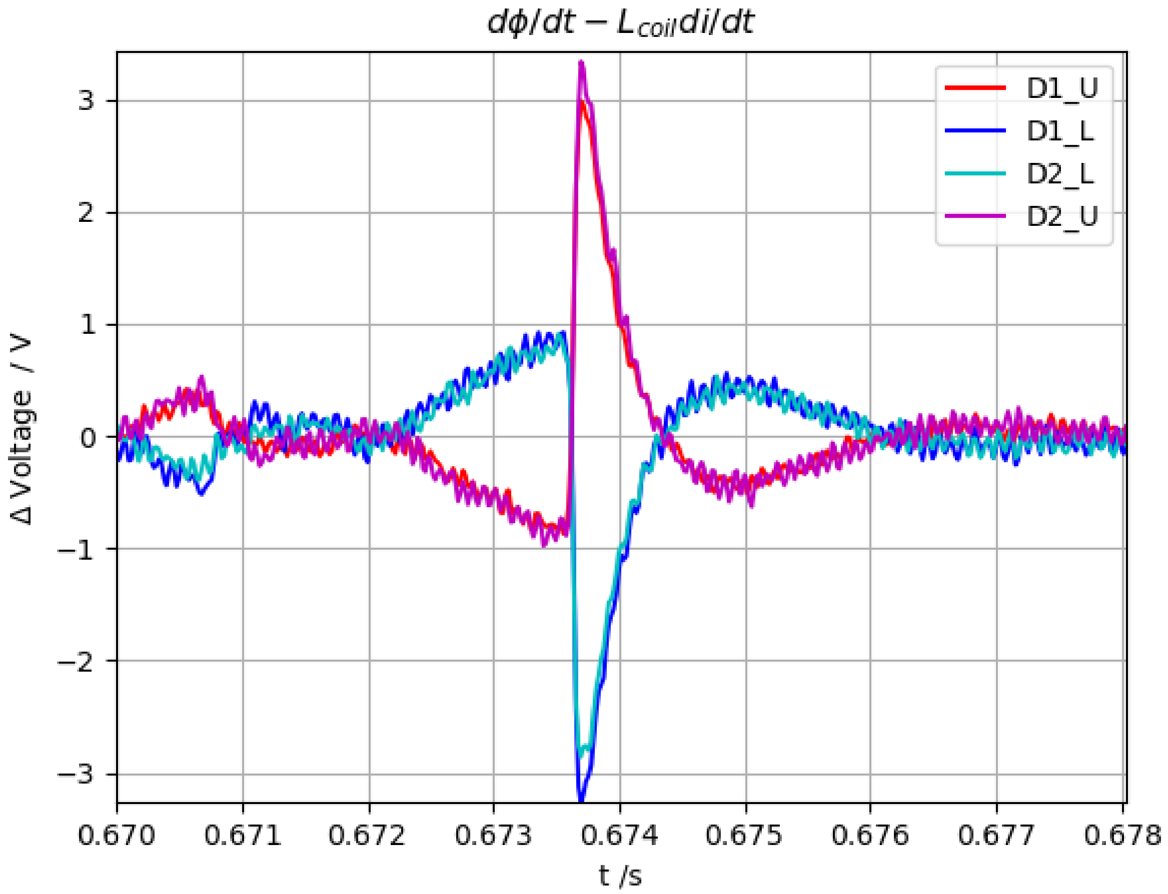

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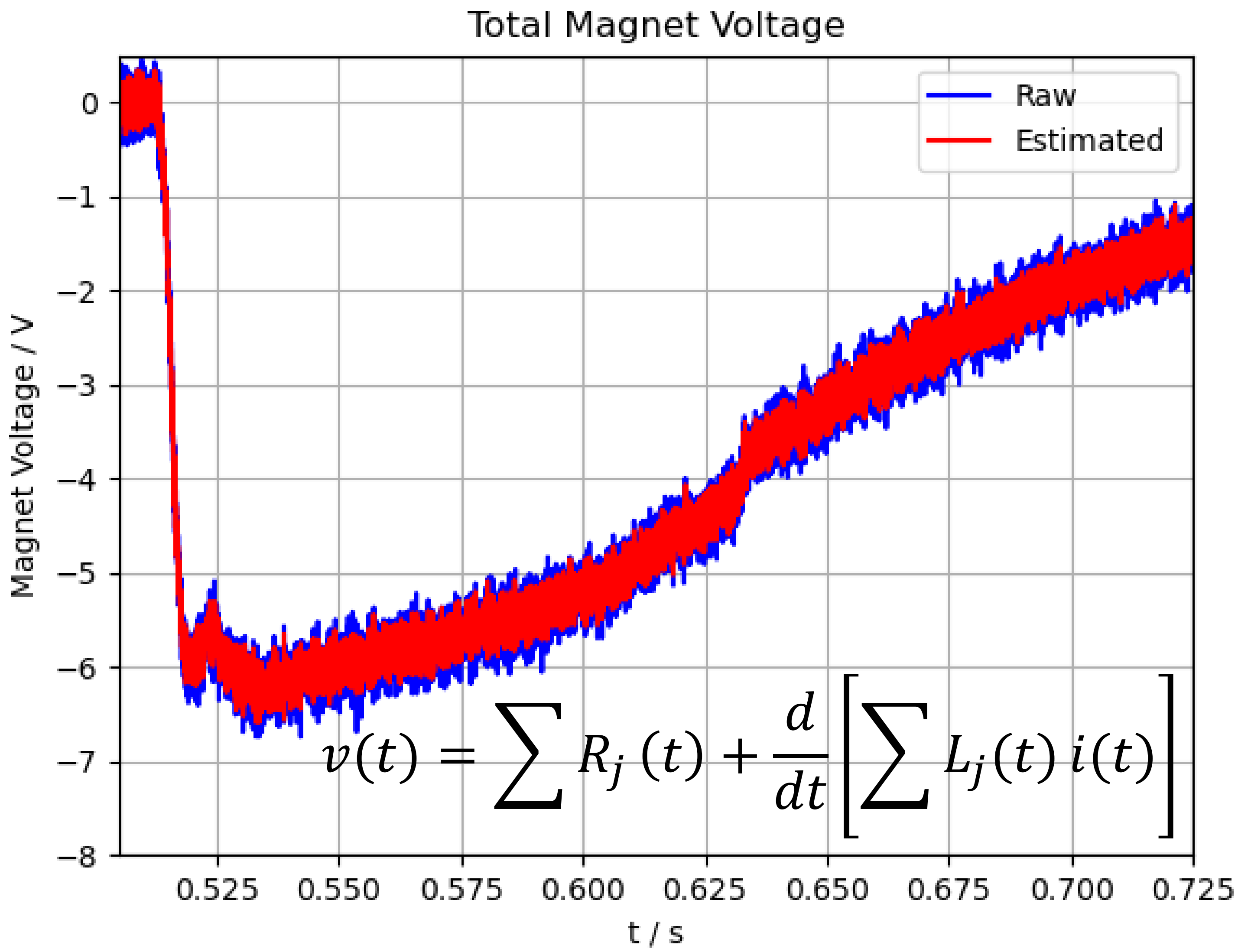

$$v(t) = \sum R_j(t) + \frac{d}{dt}\left[\sum L_j(t)\, i(t)\right]$$

Remarks

- Pure post processing of the data to solve: $\begin{cases} \frac{dL}{dt}(t) = \frac{v(t) - L(t)\frac{di}{dt}(t)}{i(t)} - \mathrm{R(t)} \\ L(0) = L_{coil} \end{cases}$
- Symmetry issue still open
  - In this case no “active” device is imposing the magnet voltage $v_{magnet}(t)$
  - However, impact on the circuit current $i_{DCCT}(t)$ is (expected to be) very limited
    - $i_{DCCT}(t) \cong i_{DCCT}^{no\ spikes}(t)$ as coils inductances are changing in the 10^{-5} range : $L/_R$ unaffected
  - Hence $v_{magnet}(t) = R(t)i_{DCCT}(t) + \frac{d}{dt}\phi(t) = R(t)i_{DCCT}(t) + \frac{d}{dt}[L(t)i_{DCCT}(t)] \cong$ $R(t)i_{DCCT}(t) + L(t)\frac{d}{dt}i_{DCCT}(t) = -R_{cable}i_{DCCT}(t) - v_{diode}$
    - is this a valid argument? Or, most likely, symmetry needs to be explained “before” ?
  - Anyway it seems that the question is: can a delta inductance of $\sim$ 150 nH (10ppm) be somehow explained in the coils (by self or mutual couplings) ?

Additional Slides

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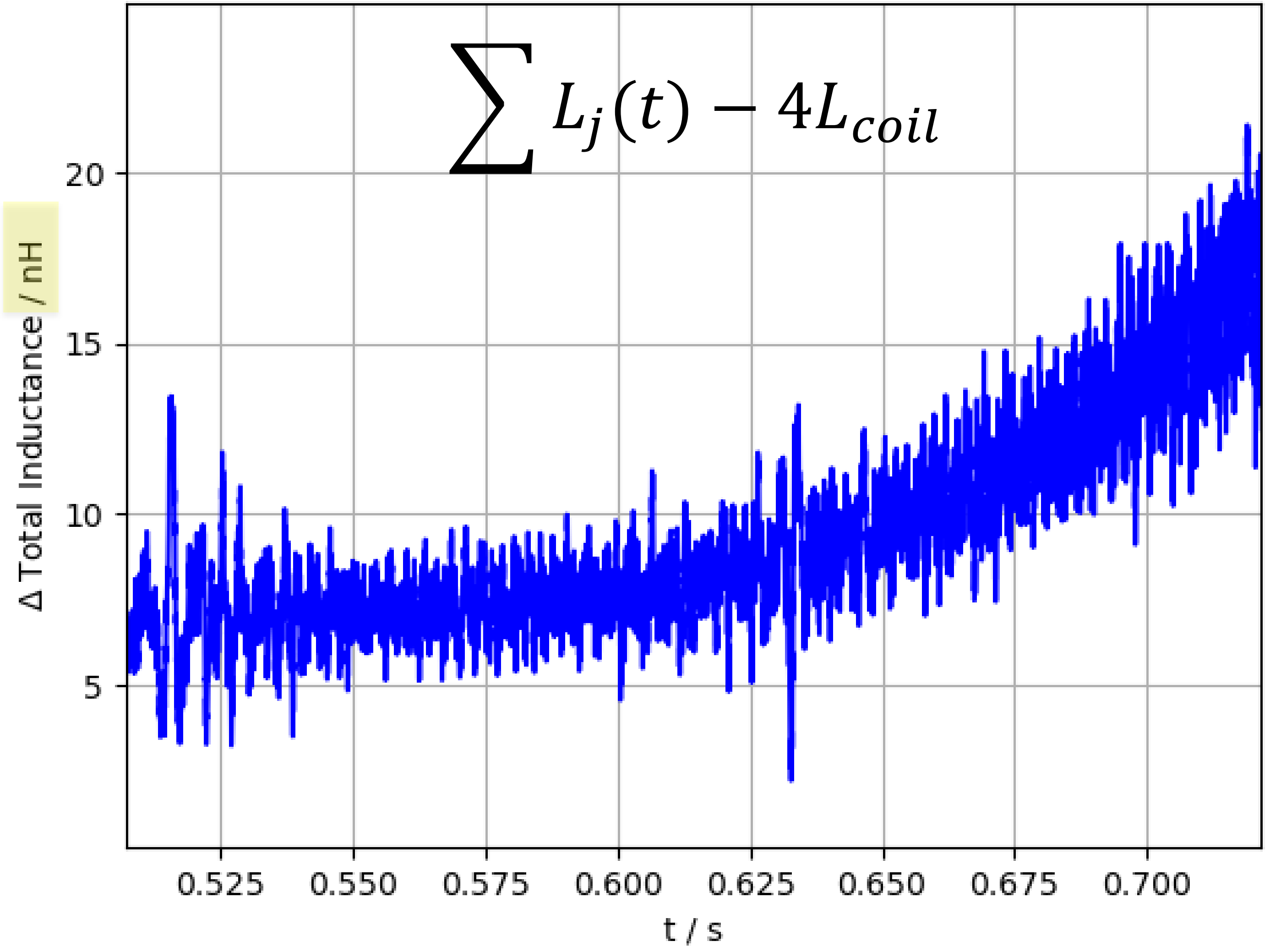

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