Correction

Correction to “Estimation of Series Capacitance of a Transformer Winding Based on Frequency-Response Data: An Indirect Measurement Approach”

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The above cited paper was published in the October 2011 issue [1]. It reported two specific experimental results on actual windings viz., one on a fully interleaved-disc winding and another on a continuous-disc winding. During exploration of alternative methods for the estimation of series capacitance (C_s), the authors had to conduct measurements on the same two windings, and the newly estimated values of C_s were found to disagree with those reported in [1]. This pointed to possible errors in measurements in [1] since the simulation, analytical parts, and recent experiments were thoroughly checked and found to be correct.

A step-by-step tracking of the measurement process in [1] led to the discovery that the error had crept in due to a faulty measuring cable used to acquire the driving-point-impedance (DPI) data, which happened to be one of the primary inputs for the method in [1]. The same faulty cable had also been used to measure total shunt capacitance C_g as well as the initial impulse voltage distribution. This was the reason for an agreement between the measured and estimated initial impulse voltage distribution. This faulty cable was subsequently identified and removed. Presented below are all of the pertinent measurements and calculations so that the earlier results are replaced by the new set. At this juncture, the authors consider it important to mention that these errata are only to supersede the earlier numerical results for the actual windings in [1], while the proposed method and its implementation remain unaltered.

Case I: Results for a fully interleaved-disc winding

1) Fig. 1 below replaces the DPI plot shown in [1, Fig. 3]. The details of estimating C_s pertaining to the new measurement are briefly described below.
2) The number of sections $\mathrm{n} = 4$, as four peaks are observable (and numbered) in the magnitude response in Fig. 1.
3) The corresponding DPI function (expressed as a rational function in [1]) is now, for convenience, listed in Table I in the pole-zero-gain format, along with the estimated gain K.
4) The measured value of shunt capacitance per section is $C_g = 0.11$ nF.
5) K factor $= 3.1537$.
6) Polynomial $P(C_s)$ is

$$P(C_s) = -0.6307C_s^4 + 0.2449C_s^3 + 0.1437C_s^2 + 0.0112C_s + 0.0002.$$

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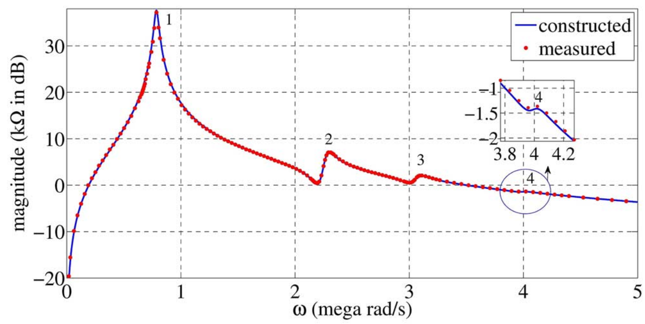

Fig. 1. DPI magnitude response of an actual isolated interleaved-disc winding (with the neutral end grounded).

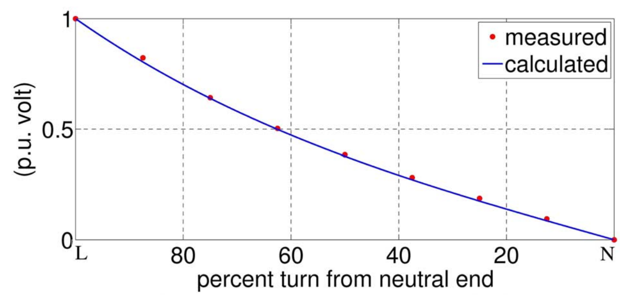

Fig. 2. Initial impulse voltage distribution for a fully interleaved-disc winding (with the neutral end grounded) measured at 0.3 μs for a ≈60 V, 0.3/40-μs impulse excitation.

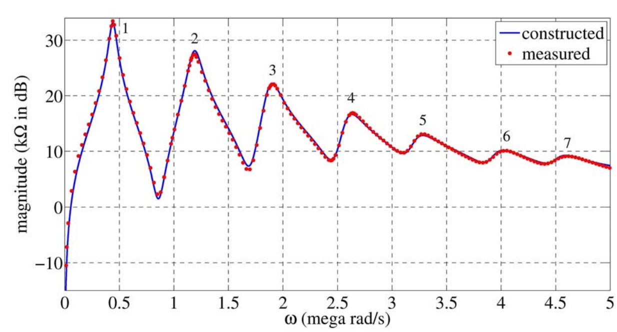

Fig. 3. DPI magnitude response of an actual continuous-disc winding (with a neutral end grounded).

7) The roots of $P(C_s)$ are −0.2535, −0.0648, −0.0263, and 0.733.
8) Thus, C_s for the interleaved-disc winding is estimated to be 0.733 nF. This value corresponds to $\alpha = 1.54$.
9) Fig. 2 is the initial impulse voltage distribution measurement and it replaces [1, Fig. 4]. The initial impulse voltage distribution was measured (at 0.3 μs) by exciting the winding using a recurrent surge generator, producing a 60 V, 0.3/40-μs impulse waveform.

Case II: Results for a continuous-disc winding

1) Fig. 3 below is the driving-point impedance and replaces [1, Fig. 5]. Details of estimating C_s pertaining to this new measurement are briefly described below.

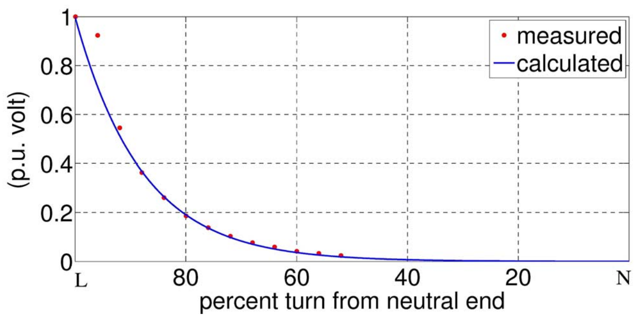

Fig. 4. Initial impulse voltage distribution for the continuous-disc winding (with the neutral end grounded) measured at 0.3 μs for a ≈60 V, 0.3/50-μs impulse excitation.

TABLE I
CONSTRUCTED DPI FUNCTION Z(s) IN P-Z-K FORMAT

#	Poles *(P)*	Zeros *(Z)*	*'K'*
1	-0.0195 ± 0.7851i	-0.003	**3.1537**
2	-0.0534 ± 2.2686i	-0.0525 ± 2.2232i	
3	-0.0616 ± 3.0597i	-0.0615 ± 3.0455i	
4	-0.0699 ± 3.9921i	-0.0699 ± 3.9900i	

2) Number of sections $n = 7$, as seven peaks are observable (and numbered) in the magnitude response in Fig. 3.
3) The corresponding DPI function is now listed in the pole-zero-gain format in Table II, and replaces the corresponding DPI in [1].
4) Measured value of shunt capacitance C_g per section is 0.106 nF.
5) K factor $= 9.54$.

TABLE II
CONSTRUCTED DPI FUNCTION Z(s) IN P-Z-K FORMAT

#	Poles *(P)*	Zeros *(Z)*	*'K'*
1	-0.0322 ± 0.4404i	-0.0026	**9.54**
2	-0.0600 ± 1.1870i	-0.0490 ± 0.8600i	
3	-0.0767 ± 1.8820i	-0.0739 ± 1.7012i	
4	-0.0991 ± 2.5874i	-0.0898 ± 2.4732i	
5	-0.1186 ± 3.2123i	-0.1108 ± 3.1504i	
6	-0.1226 ± 3.9367i	-0.1151 ± 3.8932i	
7	-0.1149 ± 4.5183i	-0.1167 ± 4.4895i	

6) The polynomial $P(C_s)$ is

$$P(C_s) = -0.1228C_s^7 - 0.2279C_s^6 - 0.0583C_s^5 - 0.0032C_s^4 + 0.0002C_s^3 + 0.00003C_s^2 + 0.8393 * 10^{-6}C_s + 0.8904 * 10^{-8}.$$

7) Roots of $P(C_s)$ are -1.5632, -0.1987, -0.0694 ± 0.0480 i, -0.0169 ± 0.0113i, 0.0789
8) Thus, C_s for the continuous-disc winding was estimated to be 0.0789 nF. This value corresponds to an $\alpha = 8.1032$.
9) Reference [1, Fig. 6] depicting the initial impulse voltage distribution is replaced by Fig. 4 here. The initial impulse voltage distribution was measured (at 0.3 μs) by exciting the winding using a recurrent surge generator, producing a 60-V, 0.3/50-μs impulse waveform.

REFERENCES

[1] S. Pramanik and L. Satish, "Estimation of series capacitance of a transformer winding based on frequency-response data: An indirect measurement approach," *IEEE Trans. Power Del.*, vol. 26, no. 4, pp. 2870–2878, Oct. 2011.