

# The Amount Did Not Fall and the Certainty Did

— The amount per item rose from **1.009** to **1.198** while the  $t$  value fell from **2.74** to **1.75** — inversion puts the standard error at **1.8590** times its former size — the transfer function of a dead time has magnitude exactly **1** at every frequency — [Paper 425]

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— *From thinking to syncing.* —

## Abstract

Delaying a procedure is expected to cost performance. This paper shows that the amount can hold while only the certainty falls—and that watching the amount alone will never show it. No new theorem or law is claimed. First, this is the core of the paper. After the delay, the amount per item rose from **1.009** to **1.198** while the  $t$  value fell from **2.74** to **1.75** (Section 2). Second, inversion puts the standard error at **1.8590** times its former size, nearly double (Section 2). Third, the inversion passes its own test: reconstructing  $t$  returns **1.750000000** (Section 2). Fourth, the transfer function of a dead time has magnitude exactly **1.000000000000** at every frequency (Section 3). Fifth, what is lost is phase alone, and it is lost in proportion to the frequency (Section 3). Sixth, the separator is whether one watches the amount or the certainty (Section 4).

Scope of this paper (scope note): No new theorem or law is claimed—the transfer function of a dead time, phase margin, and the definition of the  $t$  statistic are all standard. No control system is designed—compensators and predictors are not the subject. No particular field is discussed—the figures come from observations of a time series, but neither the subject nor any method is. No stability is proved—Section 3 states a property of a transfer function; it does not claim that this system becomes unstable. The validity of the  $t$  value is not discussed—independence and distributional assumptions are not the subject;  $t$  is used as “the amount divided by its dispersion”. Causes are not discussed—why the dispersion grew cannot be settled from these observations. Relation to earlier papers: Paper 350 showed that a dead time eats the stability margin without touching the amplitude—this paper adds a measurement showing the same shape appearing in a statistical test. Paper 424 showed that dividing turns a move in the denominator into an event—there the denominator moved; here only the denominator moves while the numerator does not. Paper 300 showed that common root and distinct root can be decided—“the amount falls” and “the certainty falls” are distinct roots by that criterion. Paper 422 showed that the win rate moves while the expectation does not—there only one of the two moved; here too. What is added is setting the amount and the  $t$  value moving in opposite directions side by side, fixing the ratio of standard errors at 1.8590 by inversion, testing that inversion by reconstruction, confirming numerically that the magnitude of a dead time is exactly 1, showing that the phase is lost in proportion to frequency, and placing the separator at “amount or certainty”.

## 1. Notation and the Question

Setting: For a sample mean  $m$ , standard deviation  $s$  and count  $n$ , the  $t$  statistic is

$$t = \frac{m\sqrt{n}}{s} = \frac{m}{\text{SE}}, \quad \text{SE} = \frac{s}{\sqrt{n}}$$

And the transfer function of a dead time  $T$  is  $G(\omega) = e^{-i\omega T}$ .

### Observation 1.1

Delaying a procedure is expected to cost performance. Opportunities are missed—so if the amount holds after a delay, one reads it as safe.

### Observation 1.2

But “amount” and “certainty” are different quantities.  $t$  is the amount divided by its dispersion—and it moves when the denominator moves, even if the numerator does not.

Question: Under a delay, which of the two moves.

2. The Amount Rose and t Fell

Computation 2.1: Measure the same sample before and after the delay.

| Delay   | Amount per item | $t$  |
|---------|-----------------|------|
| None    | 1.009           | 2.74 |
| Applied | 1.198           | 1.75 |

Observation 2.2

The amount did not fall.It rose by a factor of 1.1873—a shape that reads as “the delay did no harm”.

Observation 2.3

In the same sample,  $t$  fell by a factor of 0.6387.From 2.74 to 1.75—crossing the customary landmark of 2 from above.

Computation 2.4: Since  $t = m/SE$ , the ratio of standard errors can be inverted out.

$$\frac{SE_1}{SE_0} = \frac{m_1/m_0}{t_1/t_0} = \frac{1.1873}{0.6387} = \mathbf{1.8590}$$

Observation 2.5

The standard error nearly doubled.A factor of 1.8590—which accounts for a fifth more amount going with two fifths less  $t$ .

Observation 2.6

Test the inversion itself.Reconstructing  $t$  from that ratio returns 1.750000000—confirming the algebra.

### Observation 2.7

The cause is not settled. Whether the count fell or the dispersion grew cannot be separated from these two numbers—what is known is only that the denominator grew by 1.8590.

## 3. A Dead Time Does Not Touch the Magnitude at All

Computation 3.1: Take the magnitude and phase of  $e^{-i\omega T}$  at  $T = 1$  for three frequencies.

| $\omega$ | Magnitude $ G $ | Phase                  |
|----------|-----------------|------------------------|
| 0.1      | 1.000000000000  | −5.73 deg              |
| 1.0      | 1.000000000000  | −57.30 deg             |
| 10.0     | 1.000000000000  | wrapped to +147.04 deg |

### Observation 3.2

The magnitude is exactly 1 at every frequency. To twelve decimal places—not an approximation but the identity  $|e^{-i\theta}| = 1$ .

### Observation 3.3

What is lost is phase alone. And it is lost in proportion to  $\omega T$ —the faster the component, the more is taken.

### Observation 3.4

So an instrument that watches only magnitude does not register a dead time. Nothing appears to have been lost—which is the shape Paper 350 described.

### Observation 3.5

The measurement of Section 2 matches that shape. The amount, a magnitude, did not fall; only  $t$ , a certainty, did—though this paper does not show that this system is a control system. It says only that the shape is the same.

## 4. The Separator

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The separator: does one watch the amount or the certainty.

### Observation 4.1

The amount can survive a delay. What is missed in one place can be made up in another—a mean is a blunt quantity.

### Observation 4.2

The certainty falls. The same mean is now carried on a larger dispersion—so more sample is needed for the same conclusion.

### Observation 4.3

These are distinct roots by the criterion of Paper 300. Both are called “the effect of the delay”—one is about the numerator, the other about the denominator.

### Observation 4.4

So a delay test must not watch the amount alone. “The amount survived the delay” is not evidence of passing—if  $t$  crossed the landmark, the conclusion has changed.

#### Observation 4.5

Path-dependent procedures deserve particular care. A procedure that decides its next step from intermediate values follows a different path once a delay is inserted—and the dispersion can swell without anything appearing in the amount.

#### Observation 4.6

To be honest—this paper only inverted a ratio of standard errors out of two pairs of numbers. Whether the count or the dispersion moved is not separated—separating them requires recording both.

#### Observation 4.7

One last thing—a fall in  $t$  is not the disappearance of the effect.  $1.75$  is not zero—all that can be said is that more is needed for the same certainty.

## 5. Roll Call and Closing

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1. The amount goes  $1.009 \rightarrow 1.198$  (Computation 2.1): **it did not fall.**
2.  $t$  goes  $2.74 \rightarrow 1.75$  (Computation 2.1): **in the same sample.**
3. The amount ratio is  $1.1873$  (Observation 2.2): **a fifth more.**
4. The  $t$  ratio is  $0.6387$  (Observation 2.3): **two fifths less.**
5. The standard error ratio is  $1.8590$  (Computation 2.4): **by inversion.**
6. Reconstruction returns  $1.750000000$  (Observation 2.6): **the algebra holds.**
7. Magnitude is  $1.000000000000$  at all three (Computation 3.1): **an identity.**
8. Phase is lost in proportion to  $\omega T$  (Observation 3.3): **faster costs more.**
9. A magnitude-only instrument sees nothing (Observation 3.4): **the shape of Paper 350.**
10. The separator is amount or certainty (Observation 4.3): **distinct roots by Paper 300.**

Closing: Delaying a procedure is expected to cost performance, because opportunities are missed—so if the amount holds after a delay, one reads it as safe. But “amount” and “certainty” are different quantities. In the measurement the amount rose and the certainty fell—in the same sample the amount per item rose from  $1.009$  to  $1.198$ , a factor of  $1.1873$ , while the  $t$  value fell from  $2.74$  to  $1.75$ , a factor of  $0.6387$ , crossing the customary landmark of  $2$  from

above. Since  $t = m/SE$  the ratio of standard errors inverts out as  $1.1873/0.6387 = \mathbf{1.8590}$ , nearly double—which accounts for a fifth more amount going with two fifths less  $t$ . The inversion is itself tested: reconstructing  $t$  from that ratio returns  $\mathbf{1.750000000}$ . Whether the count fell or the dispersion grew cannot be separated from these two numbers. The same shape is written into the transfer function of a dead time—the magnitude of  $e^{-i\omega T}$  is exactly  $\mathbf{1.000000000000}$  at all three frequencies, not an approximation but the identity  $|e^{-i\theta}| = 1$ . What is lost is phase alone, and in proportion to  $\omega T$ , so the faster the component the more is taken. An instrument that watches only magnitude therefore does not register a dead time—nothing appears to have been lost, which is the shape Paper 350 described. This paper does not show that this system is a control system; it says only that the shape is the same. One thing separates them—does one watch the amount or the certainty. The amount can survive a delay, since what is missed in one place can be made up in another, and a mean is a blunt quantity. The certainty falls: the same mean is carried on a larger dispersion, so more sample is needed for the same conclusion. They are distinct roots by the criterion of Paper 300, one about the numerator and one about the denominator. So a delay test must not watch the amount alone—“the amount survived” is not evidence of passing, and if  $t$  crossed the landmark the conclusion has changed. Path-dependent procedures deserve particular care, since one that decides its next step from intermediate values follows a different path once a delay is inserted, and the dispersion can swell without anything appearing in the amount. To be honest—this paper only inverted a ratio of standard errors out of two pairs of numbers, and whether the count or the dispersion moved is not separated. Separating them requires recording both. One last thing—a fall in  $t$  is not the disappearance of the effect.  $1.75$  is not zero, and all that can be said is that more is needed for the same certainty.

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