



AN EMPIRICAL STUDY OF IMPULSIVE POTENTIAL SOURCE WITH STEP FUNCTION

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ABSTRACT

The impulsive response of network circuits are generally analyzed by adopting different integral transforms. The paper inquires the impulsive response of network circuits by Elzaki integral transform: Elzaki Transform and proves the applicability of Elzaki Transform to get hold of the impulsive response of Electrical circuits.

Keywords: Elzaki Transform, Impulsive Response, Network Circuits.

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INTRODUCTION

The Elzaki Transform has been applied in solving initial value problems in most of the science and engineering disciplines. The Elzaki Transform was composed recently by the applied it to analyze initial value problems in science and engineering disciplines [1,2,3,4,5,6,7,8,9,10]. This transform is not broadly known since it is composed recently. The electrical circuits are usually analyzed by adopting different integral transforms or methods [11,12,13,14,15,16,17,18,19,20]. In this paper, we present a Elzaki integral analyze the impulsive response of network circuits and reveals that it can also be obtained easily by the application of Elzaki Transform.

DEFINITION

2.1 Elzaki Transform

If the function $f(y)$, $y \geq 0$ is having an exponential order and is a piecewise continuous function on any interval, then the Elzaki transform of $f(y)$ is given by

$$E\{f(y)\} = \bar{f}(p) = p \int_0^{\infty} e^{-\frac{y}{p}} f(y) dy.$$

The Elzaki Transform [1, 2, 3] of elementary functions are given by

- $E\{y^n\} = n! p^{n+2}$, where $n = 0, 1, 2, \dots$
- $E\{e^{ay}\} = \frac{p^2}{1-ap}$,
- $E\{\sin ay\} = \frac{ap^3}{1+a^2p^2}$,
- $E\{\cos ay\} = \frac{ap^2}{1+a^2p^2}$,
- $E\{\sinh ay\} = \frac{ap^3}{1-a^2p^2}$,
- $E\{\cosh ay\} = \frac{ap^2}{1-a^2p^2}$.

2.2 Inverse Elzaki Transform

The Inverse Elzaki Transform of some of the functions are given by

- $E^{-1}\{p^n\} = \frac{y^{n-2}}{(n-2)!}$, $n = 2, 3, 4 \dots$
- $E^{-1}\left\{\frac{p^2}{1-ap}\right\} = e^{ay}$
- $E^{-1}\left\{\frac{p^3}{1+a^2p^2}\right\} = \frac{1}{a} \sin ay$
- $E^{-1}\left\{\frac{p^2}{1+a^2p^2}\right\} = \frac{1}{a} \cos ay$
- $E^{-1}\left\{\frac{p^3}{1-a^2p^2}\right\} = \frac{1}{a} \sinh ay$
- $E^{-1}\left\{\frac{p^2}{1-a^2p^2}\right\} = \frac{1}{a} \cosh ay$

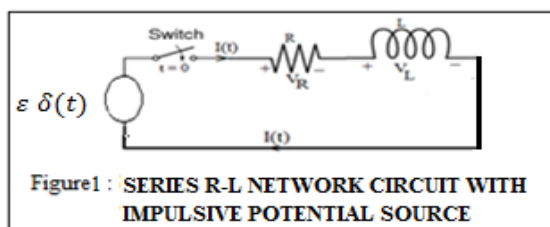
2.3 Elzaki Transform of Derivatives

The Elzaki Transform [1, 2, 3] of some of the Derivatives of $h(y)$ are given by

- $E\{\bar{h}'(y)\} = \frac{1}{p} E\{\bar{h}(y)\} - p \bar{h}(0)$
or $E\{h'(y)\} = \frac{1}{p} \bar{h}(p) - p h(0),$
- $E\{\bar{h}''(y)\} = \frac{1}{p^2} \bar{h}(p) - \bar{h}(0) - p h'(0),$
and so on.

METHODOLOGY

SERIES R-L NETWORK CIRCUIT WITH IMPULSIVE POTENTIAL SOURCE



The series R-L network circuit with impulsive potential source [4], [5] is analyzed by the following differential equation

$$L \dot{I}(t) + R I(t) = \epsilon u(t), \quad I \equiv \frac{d}{dt}$$

Or

$$\dot{I}(t) + \frac{R}{L} I(t) = \frac{\epsilon}{L} u(t) \dots (1)$$

ϵ is the strength of delta potential in volt

And $I(0) = 0.$

The Elzaki transform of equation (1) gives

$$E\{I(t)\} + \frac{R}{L} E\{I(t)\} = \frac{\epsilon}{L} \{u(t)\}$$

$$\frac{1}{L} G(q) - qI(0) + \frac{R}{L} G(q) = \frac{\epsilon}{L} q^2 \dots (2)$$

Put $I(0) = 0,$ equation (2) on simplifying gives,

$$G(q) = \frac{\epsilon q^2}{(qR + L)}$$

$$G(q) = \frac{\epsilon}{R} \left[q^2 - \frac{q^2}{(1 + \frac{R}{L}q)} \right] \dots (3)$$

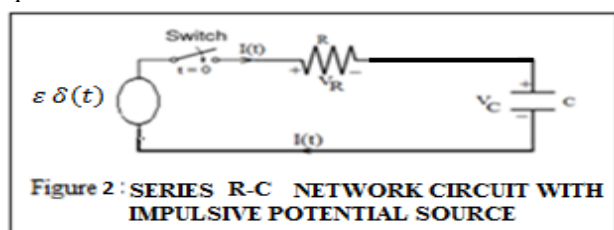
Taking inverse Elzaki Transform, we get

$$I(t) = \frac{\epsilon}{R} \left[1 - e^{-\frac{R}{L}t} \right] \dots (4)$$

This equation yields the instantaneous current through the series R-L network circuit with an impulsive potential source.

SERIES RC NETWORK CIRCUIT WITH IMPULSIVE POTENTIAL SOURCE

The series R-C network circuit with impulsive potential source [4, 5] is analyzed by the following differential equation-



$$\dot{Q}(t)R + \frac{Q(t)}{C} = \epsilon u(t) \dots (5)$$

Or

$$\dot{Q}(t) + \frac{1}{RC} Q(t) = \frac{\epsilon}{R} u(t) \dots (6)$$

Here, $Q(t)$ is the instantaneous charge and $Q(0) = 0.$

The Elzaki transform of (10) gives equations 7-11-

$$\frac{1}{q} G(q) - qG(0) + \frac{1}{RC} G(q) = \frac{\epsilon}{R} q^2$$

Put $Q(0) = 0$ we get

$$\frac{1}{q} G(q) + \frac{1}{RC} G(q) = \frac{\epsilon}{R} q^2$$

$$G(q) = \frac{\epsilon q^3 RC}{R(q + RC)}$$

$$G(q) = \frac{\epsilon q^3}{R(1 + \frac{q}{RC})}$$

OR

$$G(q) = \epsilon C \left(q^2 - \frac{q^2}{(1 + \frac{q}{RC})} \right) \dots (11)$$

Taking inverse Elzaki Transform, we get

$$I(t) = \frac{\epsilon}{R} \left[1 - e^{-\frac{R}{L}t} \right] \dots (12)$$

This equation yields the instantaneous charge through the series R-C network circuit with an impulsive potential source.

CONCLUSION

In this paper, we have obtained successfully the impulsive response of network circuits by Elzaki Transform. It is finished that the Elzaki Transform is accomplished in obtaining the impulsive response of the electrical network circuits.

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