Theory of System Excitation and System Response in Linear Systems.

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Abstract. In this research paper, the author looks at the breakthrough idea in determining system power from the system excitation and system response in a linear system. A system in question includes both homogenous and heterogenous systems. The approach in description is to find meaning of how to make a homogenous system, from homogenous to heterogenous and finally an *operatingous* system.

Keyword. *Homogenous, heterogenous, operatingous, systems, control theory, excitation, response, variable, electrical systems.*

1 Introduction

System power is a necessary condition for a linear system in order to determine the current i(t) and voltage v(t). System power is defined in terms of the system excitation and system response.

Principle of Superposition:

A necessary excitation $x_1(t) + x_2(t)$ cause can effect a correspondent response $y_1(t) + y_2(t)$ then it will have a sufficient power of $[x_1(t) + x_2(t)] \,.\, [y_1(t) + y_2(t)]$.

Mathematically, superposition power:

$$= [x_1(t) + x_2(t)] \,.\, [y_1(t) + y_2(t)]$$
$$= x_1(t) \,.\, y_1(t) + x_1(t) \,.\, y_2(t) + x_2(t) \,.\, y_1(t) + x_2(t) \,.\, y_2(t)$$
$$= [x_1(t) \,.\, y_1(t) + x_2(t) \,.\, y_2(t)] + [x_1(t) \,.\, y_2(t) + x_2(t) \,.\, y_1(t)]$$
$$= (P_1(t) + P_2(t)) + (P_{12}(t) + P_{21}(t))$$

$P_1(t) + P_2(t)$ is the *homo-power* for a homogenous systems and $P_{12}(t) + P_{21}(t)$ is the *hetero-power* for heterogenous systems.

2 Homogeneity and Heterogeneity

P(t) homogeneity : Mathematically, it can be

$P(t) = x(t)y(t) : homogeneity$ (notice the no dot product).

For a system 1 of excitation x_1 and response y_1 then

$$P_h(t) = x_1(t)y_1(t)$$

For a system 2 of excitation x_2 and response y_2 then

$$P_h(t) = x_2(t)y_2(t)$$

Homogeneity has only one excitation and one response in the same system.

P(t) heterogeneity : Mathematically, it can be

$P(t) = x(t)y(t) : heterogeneity.$

For a system 1 of excitation x_1 and response y_1 then

$$P_H(t) = x_1(t)y_1(t)$$

For a system 2 of excitation x_2 and response y_2 then

$$P_H(t) = x_2(t)y_2(t)$$

Heterogenous system will have power expressed by:

$$= [x_1(t) \,.\, y_1(t) + x_2(t) \,.\, y_2(t) = 0] + [x_2(t) \,.\, y_1(t) + x_1(t) \,.\, y_2(t)]$$

$$= [x_1(t) \,.\, y_2(t) + x_2(t) \,.\, y_1(t)].$$

From the mathematical expression, there is a need for a new system to cater for transfer power from a homogenous system to a heterogenous system. Power transfer from these systems will be operatingeneity. Electric expressions of these three systems in (non)-linear approach will be made now. This means lump element values will be used in the equations of such systems.

Power Transfer in Homogenous	Power Transfer in Heterogenous	Power Transfer in Operatingous
I, V	I^2, R	C, V
Elements		
Homogenous	Battery (I)	Voltage source (V)
Heterogenous	Battery (I)	Resistor(R)
Operatingous	Capacitor(C)	Voltage Source(V)
Equations		
Homogenous	IxV	Current x Voltage
Heterogenous	I^2xR	Square Current x Resistance

Power Transfer in Homoge-nous	Power Transfer in Heteroge-nous	Power Transfer in Operatin-gous
Operatingous	CxV	Capacitance x Voltage

In describing such systems, the analog is that a homogenous system has only battery and voltage source like an energy system for power generation. Again a heterogenous system has only battery and resistors like a power transmission system, electric devices. Finally, operatingous system is consider as such if it has only capacitor and voltage source like display systems, energy storage system.

Operatingous system can be expressed:

$P(t) = 1/2x(t)y(t)$. where capacitor : excitation (x(t) and voltage source: response (y(t)).

For physical systems:

$$P(t) = 1/2C(dv^2/dt)$$

$$= 2/2Cd(v^{2-1}/dt)$$

$$= CV$$

$$= x(t)y(t).$$

Therefore x(t) is a capacitor and y(t) is a voltage still. A capacitor is a system excitation. A capacitor is a storage and discharger of system excitation, current. A system power flowing into a homogenous system has a determined current and voltage. A system power flowing from a homogenous system can approach a heterogenous system if an ideal element of resistor is determined. A system power flowing from a heterogenous system can approach an operatingous system if a capacitor element is determined as the system excitation and a square voltage determined as the system response. Operatingous system can be determined on output system if a system power flowing from the operatingous system can approach output system if an ideal resistor or capacitor or voltage source is determined. Heterogenous and Operatingous systems are non-linear systems.

3 Conclusion

In concluding remarks, this article is describing systems of such homogenous or heterogenous or operatingous behaviour. The excitation and response variables of such systems were described mathematically. The electric elements involved in such systems were looked at thoroughly. The transformation of such systems from one to the other is made. This transformation just involves introducing and removing certain lump elements from the circuit system to made the other. The overall concept is the system power determination in quantifying such system.

Reference

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