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The Study of Relationship between Current and Acceleration on Simulation in Motor

Run Xu*

Gyeongsang National University, Metallurgical Engineering dept, Chinju, Korea

***Corresponding author:** Run Xu, Gyeongsang National University, Metallurgical Engineering dept, Chinju Korea; Email: 13953575073@163.com

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Abstract

The relationship between current and acceleration is important in motor so in this study the motor acceleration is searched and find it can increase with current in different conditions which includes voltage, resistance of armature and times. Meantime the force can increase with the current increasing too. In terms of increasing the time to 14s the acceleration will increase a certain. The maximum acceleration is 42mm/s^2 which is under condition of t=14s, Rm=12.5Ω, U=21V with armature radius of 5mm and its mass of 5.7g. The effective turn is U>Rm>t which expresses the prior factor among these three parameters.

Keywords: Current; Acceleration; Relationship; Force; Voltage; Resistance; Time; Motor

Introduction

The motor has important attribution for example the current with resistance and meantime dynamics including the acceleration is another important factor which can estimate the torque of motor. So we continue to study the dynamics of motor after current is searched [1-4]. When the current increases it will change and the force will change too. However the detail situation has been not studied by now. So it is investigated that the acceleration of armature in motor is searched in this paper in order to observe the intrinsic relationship of them. Controlling motor with series circuit resistance is important to measure the property in electricity. The test measure is complicate and difficult with wire and load. So if having a method to model its course is supposed the best one. In this study the series circuit resistance is adopted for measuring the rotation, power & torque of motor. To try to establish model to draw the curve between them and find variable value is our research destination. Once it is feasible the method will be adopted to evaluate the DC motor property in advance. In this paper to compare with actual value is to look for and find feasible parameters to map the gap between the model and practice. To regulate the resistance on series circuit will regulate the current which affects the motor load and property. So the resistance will play the role of regulating property in motor, which has an important role. In this study the deep research is done to simulate the circuit resistance for confirming the intrinsic relationship between them and look for method to search the effective factor to motor property with simulation.

Modeling and Discussion

According to power defining it gains

So $dP = d(Fv)$ (1)

Here F is motor force; v is its speed.

According to electric principle in terms of Figure 1 it has

$$\sum P = P_m + P_v = \sum (i_m^2 r_m + i_v^2 r_v) \quad (2)$$

$$P_m = i_m^2 r_m \quad (3)$$

Here P_m is motor power; P_v is variable power; r_m is motor resistance; r_v is variable resistance; i_m is motor current; i_v is variable current.

From energy conservation law it has

$$P_m t = \frac{1}{2} I_m \omega^2 = Fvt \quad (4)$$

According to (1) and (4) it has

$$\frac{1}{2} I_m \omega = FRt \quad (5)$$

Here ω is angular speed.

The rotary inertia of motor armature is

$$I_m = \frac{1}{2} m R_m^2 \quad (6)$$

From (5) it has

$$\omega = \sqrt{2FRt / I_m} \quad (7)$$

From (3) it has

$$F = 9.55 \frac{i_m^2 r_m}{2nR} \quad (8)$$

Since

$$n = \frac{30\omega}{\pi R^2} \quad (9)$$

According to (7)、(8) and (9) it has

$$\omega = \sqrt[3]{\frac{9.55 i_m^2 r_m \pi t}{15m}} \quad (10)$$

\and $$v = R \sqrt[3]{\frac{9.55 i_m^2 r_m \pi t}{15m}} \quad (11)$$

Here R_m is armature diameter; n is rotation; t is time; m is mass of rotor ie armature.

So $$a = \dot{v} = \dot{\omega} t = \frac{R}{3} \sqrt[3]{\frac{9.55 i_m^2 r_m \pi}{15mt^2}} \quad (12)$$

From (9) it has

$$n = \frac{30}{R^2} \sqrt[3]{\frac{9.55 i_m^2 r_m t}{15m\pi^2}} \quad (13)$$

And $$dT = 9.55 \frac{i_m^2 dr_m}{n} \quad (14)$$

So from (12) it has $F = ma$ (15)

P is from (3), T is from (14) and n is from (13), F is from (15). Here T is torque.

Discussion

The different parameters of Armature diameter being 10mm & 12mm, its mass and voltage being 6V、9V、12V、15V、 18V and 21V, its resistance being 2.5Ω、4.5Ω、6.5Ω、 8.5Ω、12.5Ωand time from 6s to 14s are used to simulate the equation which is deduced in Model as above. Discussion is proceeded as below. The motor acceleration will increase as its current increases and the same as above will happen as to force. When the voltage increases acceleration will be big with radius of 5mm and mass of 5.7g as seen in and resistance increases it will be big too (Figure 1). It will decrease when the voltage become big. So the effective factor turn is U>Rm>t which is concluded in this paper. In nominal current of 1A the acceleration will distribute to 3~12mm/s^2 whilst in stall current of 6A it will arrange from 10~37mm/s^2. In the same trend is gained as above mention with radius of 6mm and mass of 5.7g in armature (Figure 2).

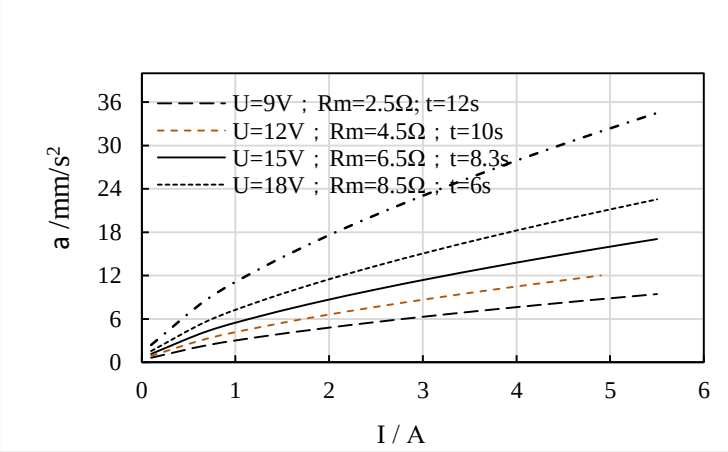

Figure 1: *The curve of acceleration and current with R=5mm, m=5.7g in the motor.*

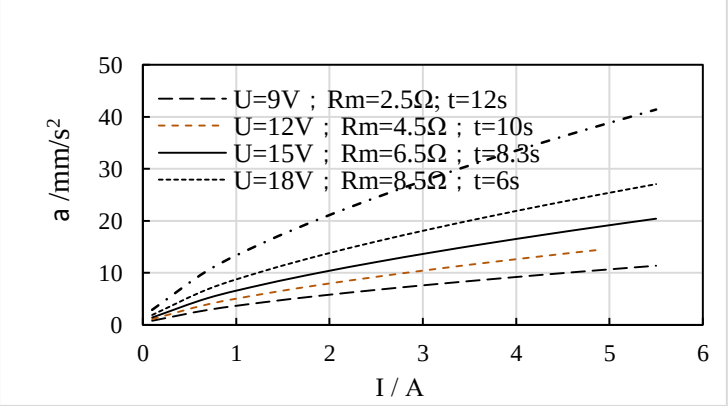

Figure 2: *The curve of acceleration and current with R=6mm, m=5.7g in the motor.*

The rate acceleration can attain from 3mm/s^2 to 15mm/s^2 whilst the stall one can attain from 10mm/s^2 to 45mm/s^2 as above mention. The force in arranges from 15N to 60N in rate status with radius of 5mm and the same mass of armature in time of 6~14s whilst it arranges from 60N to 200N in stall (Figure 3). Meantime the force in arranges from 10N to 80N in rate status with radius of 6mm and the same mass of armature in time of 6~14s whilst it arranges from 80N to 240N in stall (Figure 4). The curve of force and current with R=6mm, m=5.7g in the motor. Overview the maximum acceleration has been at t=14s, Rm=12.5Ω, U=21V whilst the minimum one has been at t=12s, R2=2.5Ω, U=9V. The effective turn is U>Rm>t which expresses the important factor among these three parameters. The former is formed through U and Rm common role so it is higher than secondary condition. This is high value which makes role to

motor rotor to increase its acceleration and force. So we choose the big voltage and resistance to promote motor rotor properties.

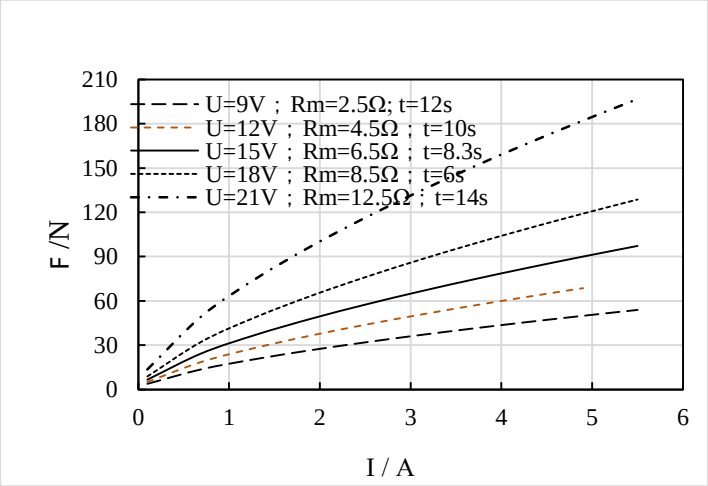

Figure 3: *The curve of force and current with R=5mm, m=5.7g in the motor.*

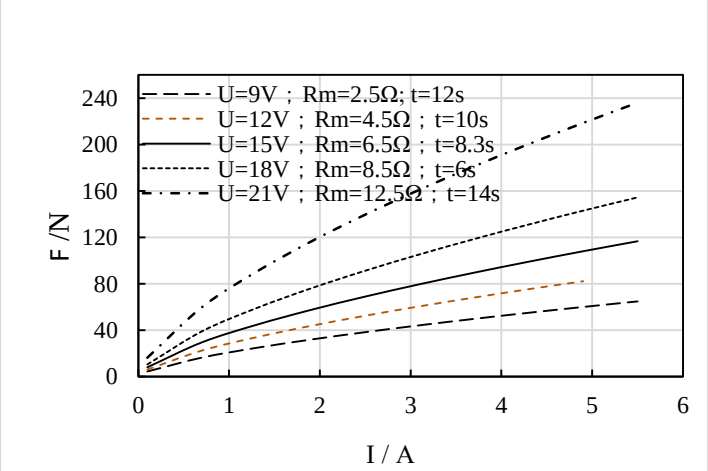

Figure 4: *The curve of force and current with R=6mm, m=5.7g in the motor.*

Conclusions

The acceleration and force can be presented in a nominal &stall status. It can be controlled through resistance. But the acceleration is too small in terms of armature radius of 5mm and time of long because of their strong role. So if we promote its value it shall be controlled that current and voltage is main factor in this research. The conditions of t=14s, Rm=12.5Ω, U=21V result in the biggest stall force 240N according to change time, resistance and voltage. Then it is t=8s, Rm=8.3Ω, U=18V; t=8s, Rm=6.5Ω, U=15V; t=10s, Rm=4.5Ω, U=12V and t=12s, Rm=2.5Ω, U=9V with the smallest 80N in turns. The effective turn is U>Rm>t which expresses the prior factor among these three parameters.

References

1. Xu R, Chen Z. Technological analysis on motor stall and its perspective. Elec Sci Eng. 2020; 1: 26-29.
2. Zenghuang Q. Electrics M Advanced Education Publisher. 2015: 264.
3. Run Xu. The Study on Simulation of Multiple Circuit Resistance in Stall Motor I. Social Sci learning Edu J. 2021; 6:1-2.
4. Yang G. Plastic Dynamics Generality Tsinghua University Press. 133.