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Review Article

The Modeling of Properties and Parameters with Variable Resistance in Series Circuit of DC Micro Motor

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Abstract: The properties like rotary、power and torque has been searched in this paper. Therein the rotary、power and torque may decline as the variable resistance increase. Detail is 5.2Kr/m at 0.2A and 0.25KW at 0.7A whilst it is 0.6Nm at 0.3A. The least one is 1Kr/m at 16Ω and 0.03KW at 8Ω whilst it is 0.12Nm at 14Ω. The better cost down is 8~16Ω whose properties are in the intermediate. It means that saving is necessary regardless of the maximum value. The rotary may decrease as the mass increases from 7.0g to 8.4g whilst the torque may increase.

Keywords: Property; modelling; parameter; variable resistance; series circuit; DC motor.

1. INTRODUCTION

The properties is an important factor to control DC motor. On the other hand the stall situation has been solved through the equation so that the measurement may be feasible only through equation establishment because the measurement is so complicated and slow. Especially the draw the stall value with parameter changing is too sophisticated therein the simple measuring could be possible by voltage and variable resistance & maintaining time. It is more convenient and rapid to use the equation [1-4].

The modeling of property like rotaty、power & torque and parameters like voltage、Rm & time has been established. It is found that all the properties can be simulate. For the sake of saving cost it is chosen with the intermediate is the best resolution. The measurement and control of motor is available upon the model equation. The continuous properties will be measured and controllable to search intrinsic nature of them which is the destination of this paper. It includes the cost down method certainly.

In short that the intrinsic nature between their properties and parameters has been shown upon the modeling equations is main task in this study. Further research may be proceeded in future to reveal their nature. As for professor and senior engineer the advice is suggested through reading the paper.

2. Modeling for motor series circuit

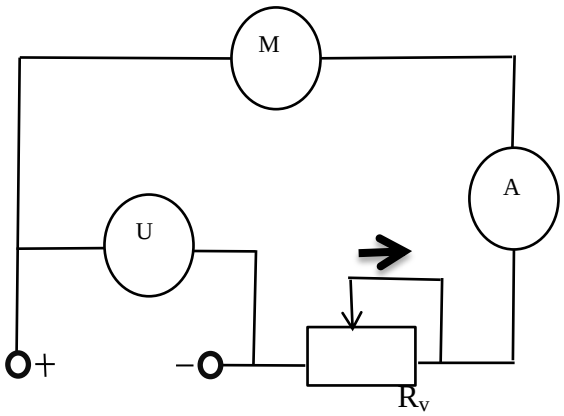

Figure 1: Circuit simulation under motor and variable resistance R_v

According to power defining it gains

So $dP = d(Fv)$ …… (1)

Here F is motor force; v is its speed.

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According to electric principle in terms of Figure 1 it has

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

$$P_m = i_m^2 r_m \quad \text{..... (3)}$$

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

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

According to (1) and (4) it has

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

Here ω is angular speed.
The rotary inertia of motor armature is

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

From (5) it has

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

From (3) it has

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

Since

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

According to (7)、(8) and (9) it has

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

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

Here R_m is armature diameter; n is rotary; t is time; m is mass of rotor ie armature.
From (9) it has

And $$dT = 9.55 \frac{i_m^2 dr_m}{n} \quad \text{..... (12)}$$

Here T is torque.

3. DISCUSSIONS

In series circuit the properties have been investigated through the relationship to resistance in this study. Detail curves are as below like rotary、power and torque. The condition is four 9~18V, 2.5~8.5Ω and 60~120s at armature mass is 6.4~8.5g.

In Figure 2(a~c) the rotary、power and torque may increase when the current increases. The biggest rotary、power and torque is 5.2Kr/m、0.25KW and 0.6Nm and 14Ω respectively. When the volatge increases from 9V to 18V the ones will increase too. The effective turn is $U>R_m>t$ which expresses the prior factor among these three parameters.

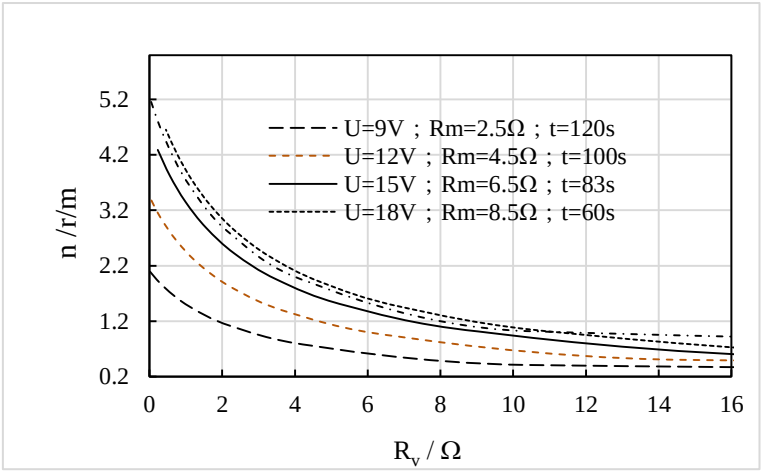
In Figure 2(a) the rotary will decline as the various resistance increases. When the voltage increases the rotary may increase too. The biggest n is 5.2Kr/m in 0.1Ω and it may decline steeply to 1.7kr/m in 6Ω. it expresses that the control of rotary is available through variable resistance under voltage、resistance and times.

As seen in Figure 2(b) the rate power can attain from 30W to 300W whilst the stall torque can attain from 150 to 600Nmm as mentioned.

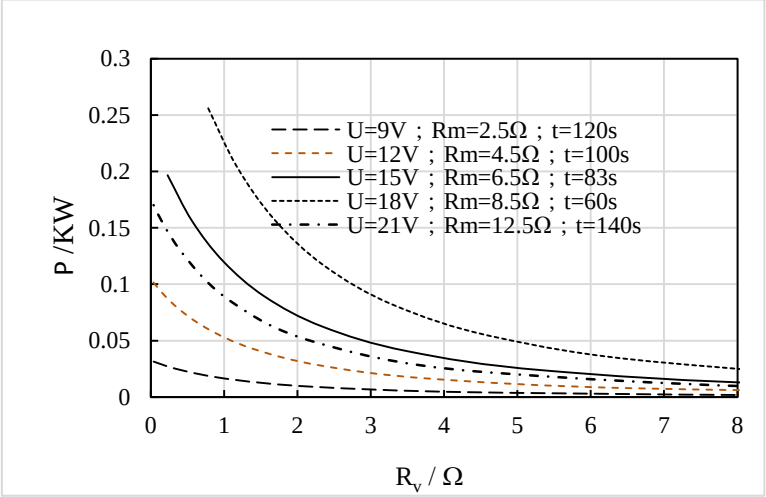
As seen in Figure 3(a~d) the same trend is gained as above mention with mass of 7.0~8.5g in armature. When the voltage increases torque will be big with mass increasing in Figure 3(a~d) and resistance increases it will be big too. It will decrease when the voltage become big. So the effective factor turn is $U>R_m>t$ which is concluded in this paper. In Figure 3 on nominal current of 0.1Ω the torque will distribute to 0.18~0.7Nm whilst in stall current of 12Ω it will arrange from 0.02~0.15Nm.

Overview the maximum torque has been at U=18V, R_m=8.5Ω, t=60s whilst the minimum one has been at U=9V, R_2=2.5Ω, t=120s. The effective turn is $U>R_m>t$ which expresses the important factor among these three parameters. The former is formed through U and R_m common role so it is higher than secondary condition. This is high value which makes role in motor rotor to increase its torque and force. So we choose the big voltage and resistance to promote motor rotor properties.

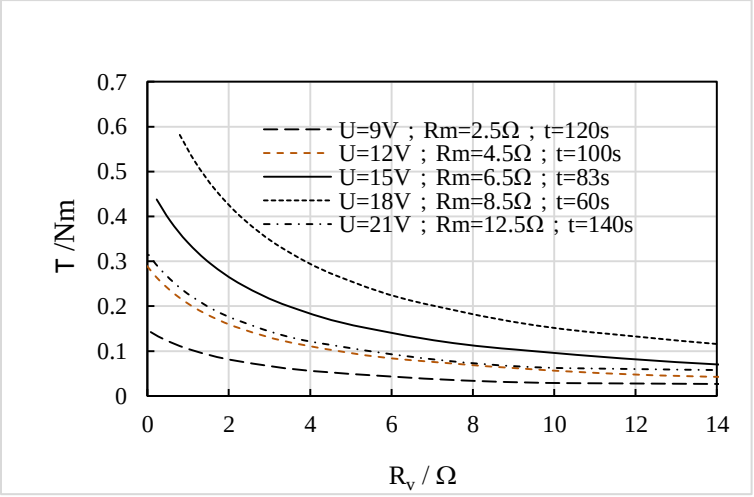
In terms of Figure 3 it is found that rotary speed may decline meantime the torque may increase as the armature mass changes from 7.0g to 8.5g. The former is maximum one from 5Kr/m to 4.4Kr/m meantime the later is from 0.6Nm to 0.68Nm. Furthermore as to the minimum one former is from 2Kr/m to 1.8Kr/m and later is from 0.15Nm to 0.18Nm respectively. The condition of U=21V, R_m=12.5Ω, t=140s is the intermediate status because of its longer time.



(a) n-Rv

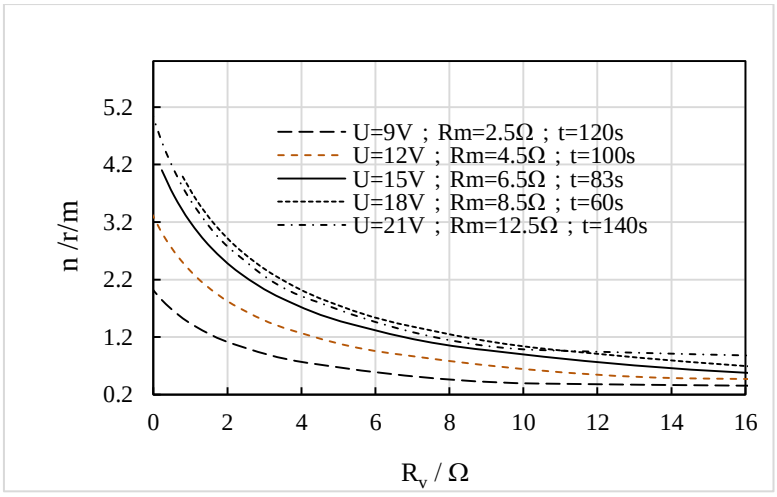


(b) P-Rv

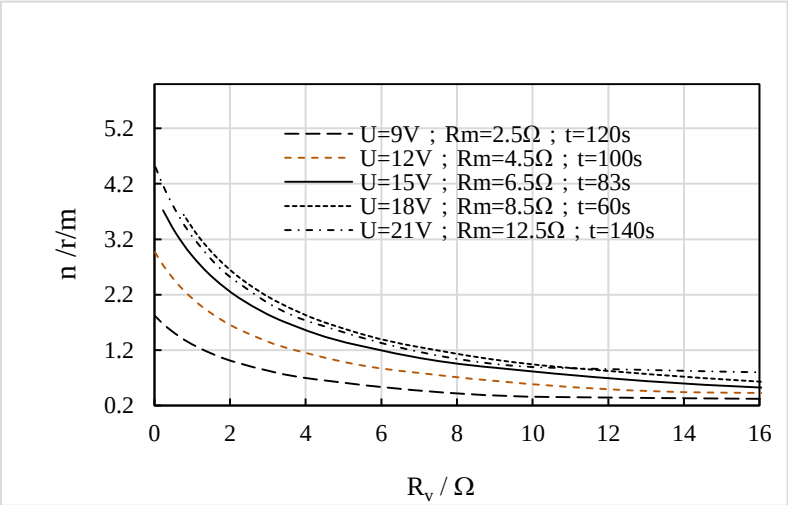


(c) T-Rv

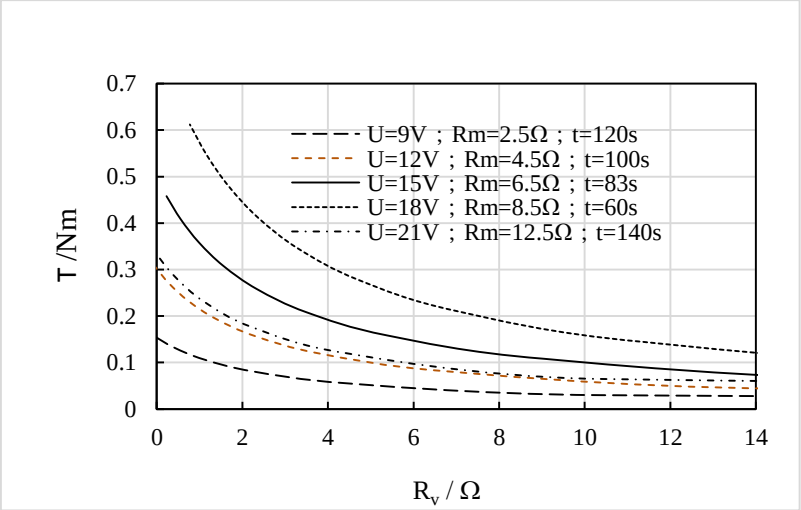
Figure 2: The curves between properties (n 、P &T) and Rv with 6.4g、voltage、Rm & time in DC micro motor



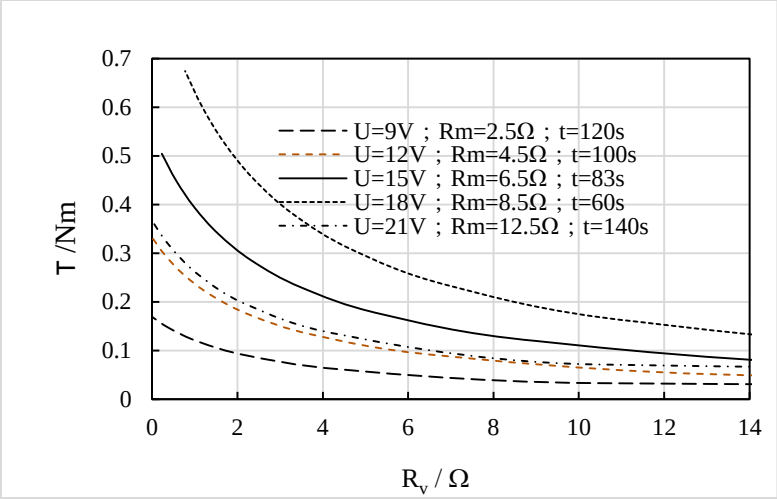
(a) m=7.0g; n



(b) m=8.5g; n



(c) m=7.0g; T



(d) m=8.4g; T

Figure 3: The curves between properties (n 、T) and Rv with armature mass、voltage、Rm & time in DC micro motor

4. CONCLUSIONS

The torque can be presented in a nominal &stall status. It can be controlled through resistance. But the torque is controlled in terms of armature mass because of their certain role. So if we promote its value it shall be controlled that current and voltage is main factor in this research. The conditions of U=18V, R_m=8.5Ω, t=60s result in the biggest stall force 700Nm according to change time, resistance and voltage. Then it is U=15V, R_m=6.5Ω, t=83s; U=21V, R_m=12.5Ω, t=140s ;U=12V, R_m=4.5Ω, t=100s and U=9V, R_2=2.5Ω, t=120s with the smallest 150Nm in turns. The effective turn is U>R_m>t which expresses the prior factor among these three parameters.

REFERENCES

1. Run, X., & Zhiqing, C. (2020). Technological Analysis on Motor Stall and its Perspective. Electrical Science & Engineering, 2(1), 26-29.
2. Qin, Z. (2015). Electrics. Advanced Education Publisher, 264
3. Run, X. (2021). The Study of Relationship between Current and torque on Simulation in Motor, Sun Text Review of Material Science, S1, 101. DOI: https:// doi.org/10.51737/2766-5100.2021.S1.001
4. Guitong, Y. Plastic Dynamics Generality [M], Tsinghua Universoty Press, 133.

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