OSTBAYERISCHE TECHNISCHE HOCHSCHULE REGENSBURG

DC MACHINE - SMALL

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***Abstract*—**

I. IDLE MODE EXPERIMENT

A. Electric motor force

The machine is operated without (a) load. This way the voltage U_q which is induced in the generator can be measured. The induced voltage is also called electric motor force (EMK).

For this experiment the initial 5000rpm will be reduced by 1000rpm each time. At 5000rpm the motor has its maximum voltage $U_A = 11.94V$.

The machine constant c and the magnetic flux Φ_E are experimentally determined (different for each machine).

$$c \cdot \Phi_E = \frac{U_q}{n} = \frac{8.8\text{V}}{4000/60\text{s}} = 0.132\text{Vs} \tag{1}$$

The arithmetic mean is calculated using the following formula.

$$\frac{\sum_{k=1}^{5} c \cdot \Phi_E}{5} = \frac{0.6621Vs}{5} = 0.13242Vs \tag{2}$$

$n[min^{-1}]$	$EMK[V]$	$U_A[V]$	$I_A[A]$	$c \cdot \varphi_E[Vs]$
5000	11.10	11.94	0.420	0.1332
4000	8.80	9.61	0.390	0.1320
3000	6.60	7.30	0.357	0.1320
2000	4.43	5.00	0.327	0.1329
1000	2.20	2.68	0.276	0.1320

Table I: Idle Mode

II. LOADED GENERATOR MODE

In the generator mode the generator is powering the machine. The rotations per minute are set at 4000rpm. In the previous experiment we measured the motor voltage at 4000rpm. Through out this experiment this voltage will be kept at $U_q(4000rpm) = 8.8V$. The load resistors are getting connected into the circuit one by one.

To determine the resistance R_A of the generator we need the potential over said resistor as well as the current running through it.

$$R_A = \frac{U_{RA}}{I_A} = \frac{U_A - U_q}{I_A} \tag{3}$$

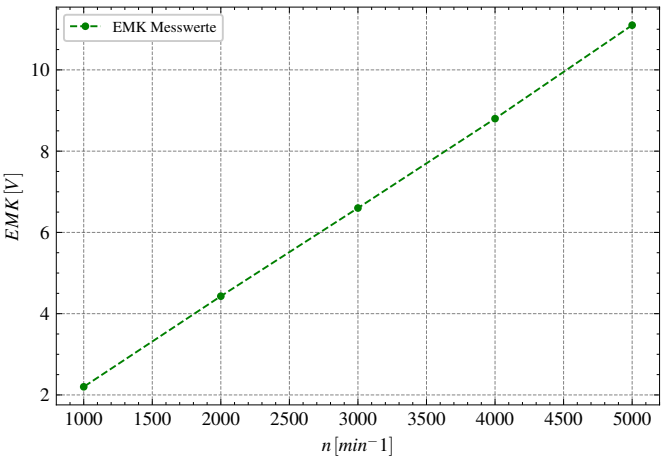

Figure 1: Idle Mode

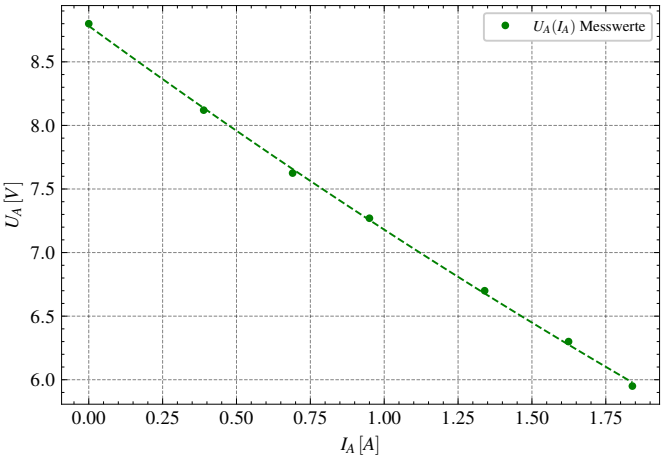

Figure 2: loaded generator mode

With the formula of the arithmetic mean

$$\frac{\sum_{k=1}^{6} c \cdot R_A}{6} = 1,62\Omega \tag{4}$$

III. LOADED MOTOR MODE

In the motor mode the voltage U_A is kept constant, first at 9V later at 12V.

The correlation between rotor rotations and voltage are given:

$$n_0 = \frac{U_A}{c \cdot Phi_E} \tag{5}$$

The correlation between the inner torque and armature current:

$$M_i = \frac{c \cdot \Phi_E \cdot I_A}{2\pi} \tag{6}$$

Between the inner and the measured torque, Power is lost through Copper P_{Cu} and friction P_{fric}.

Switches	$n[min^{-1}]$	$I_A[A]$	Weight$[g]$	$M[m\,Nm]$
All Open	3766	0.386	8.08	7.924
S1	3548	0.724	9.29	9.110
S2	3385	0.958	10.75	10.54
S1+S2	3261	1.146	11.53	11.31
S1+S2+S3	3080	1.400	13.75	13.48
S1+S2+S3+S4	2962	1.565	15.15	14.86
All Closed	2868	1.680	16.70	16.38

Table II: Belasteter Motor $U_A = 9V$

Switches	$n[min^{-1}]$	$I_A, [A]$	Weight $[g]$	$M[m\,Nm]$
All Open	5100	0.41	8.06	7.90
S1	4760	0.87	8.66	8.49
S2	4563	1.20	9.22	9.04
S1+S2	4390	1.44	10.15	9.95
S1+S2+S3	4150	178.00	12.48	12.24
S1+S2+S3+S4	3980	2.02	14.60	14.32
All Closed	3910	2.20	16.93	16.60

Table III: Belasteter Motor $U_A = 12V$

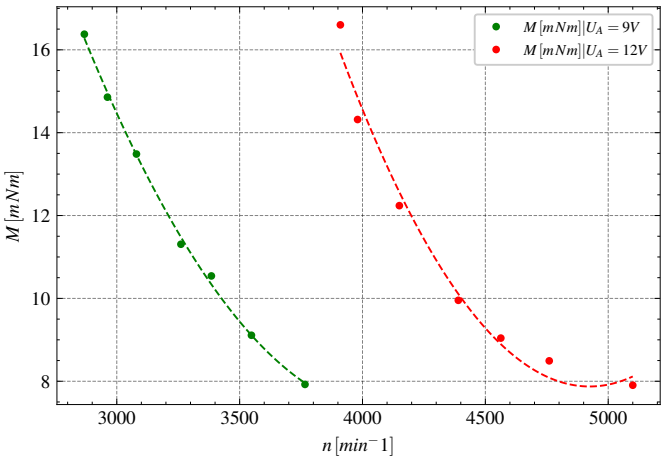

Figure 3: loaded motor mode