Referat de laborator
Determinarea rezistentei electrice prin metodele amonte/aval

Licu Mihai George CTI 162

1. Teoria lucrarii

Scopul lucrarii consta in a determina care din cele doua montaje ofera o valoare a rezistentei $R_1 = \frac{U}{I}$ mai apropriata de adevar.

Rezistenta electrica a unui mediu prin care trece curent electric este definita de raportul dintre tensiunea intre capetele mediului si intensitatea curentului care trece prin mediul respectiv. Aceasta este notata in SI cu litera R fiind masurata in Ω ($\frac{V}{A}$) .

Intensitatea curentului electric printr-un rezistor este direct proportionala cu tensiunea intre capetele acestui rezistor.$\frac{U}{I} = R$

Eroarea va fi evaluata prin eroarea relativa $\left|\frac{\Delta R}{R}\right| = \left|\frac{R_1 - R}{R}\right|$.

2. Datele experimentale neprelucrate

$R_A = 9\Omega$; $R_V = 200000\Omega$

Aval		Amonte	
U(V)	I(A)	U(V)	I(A)
3.2	0.0082	3.6	0.0088
3.4	0.0068	3.6	0.072
3.4	0.0058	3.8	0.006
3.4	0.005	3.8	0.0052
5.6	0.007	3.8	0.0046
5.8	0.0064	6.6	0.0072
5.8	0.0058	6.6	0.0066
8	0.0072	6.8	0.006
8	0.0066	6.8	0.0056
8	0.0062	6.8	0.005
8	0.0058	6.8	0.0048
8	0.0052	6.8	0.0044
8	0.005	6.8	0.0042
8	0.0048	8.8	0.0054
8	0.0044	8.8	0.005

8	0.0042	8.8	0.0048
8	0.004	8.8	0.0044
9	0.0042	8.8	0.0042
9	0.004	8.8	0.004
9	0.0038	8.8	0.0038
9	0.0038	8.8	0.0036

3. Schema montajului experimental

Metoda Aval consta in conectarea voltmetrului direct la bornele rezistorului sau a portiunii de circuit considerate, dupa ampermetru, pentru a masura rezistente electrice mici. Rezistenta voltmetrului ideal R_v este suficient de mare incat curentul care il strabate I_V este foarte mic si rezultate masuratorilor de curent si tensiune electrica nu vor fi influentate.

$$R = \frac{U}{I_R} = \frac{U}{I - I_V} = \frac{U}{I - \frac{U}{R_V}}$$

Cand $R << R_V \Rightarrow I_R \approx I \Rightarrow \left|\frac{\Delta R}{R}\right|$ mica.

Dar daca $R \approx R_V$ (rezistenta mare) $\Rightarrow I_R \approx \frac{I}{2} \Rightarrow \left|\frac{\Delta R}{R}\right|$ mare.

In cazul metodei Amonte, voltmetrul este conectat in paralel cu portiunea de circuit care include si ampermetrul si este folosita pentru a masura rezistente electrice mari. Rezistenta ampermetrului ideal R_A este insemnificativ de mica ca sa influenteze rezultatele masuratorilor curentului si a tensiunii electrice.

$$R = \frac{U_R}{I} = R = \frac{U - U_A}{I} = \frac{U - R_A I}{I}$$

Cand $R >> R_A \Rightarrow U_R \approx \frac{U}{2} \Rightarrow \left|\frac{\Delta R}{R}\right|$ mare.

Dar daca $R \approx R_A \Rightarrow U_R \approx U \Rightarrow \left|\frac{\Delta R}{R}\right|$ mica.

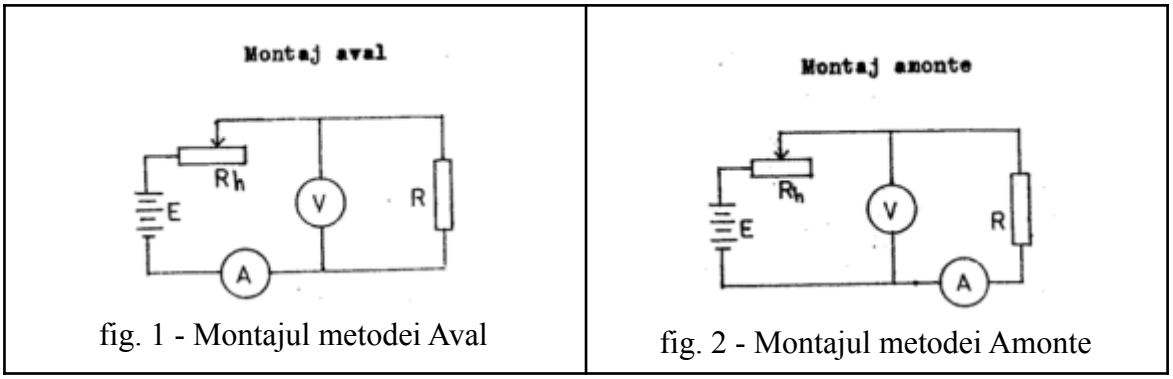


fig. 1 - Montajul metodei Aval

fig. 2 - Montajul metodei Amonte

4. Prelucrarea datelor experimentale

$$\left|\frac{\Delta R}{R}\right|_{av}=\left|\frac{R_1-R}{R}\right|=\left|\frac{\frac{U}{I}-R}{R}\right|=\left|\frac{\frac{U}{I}-\frac{U}{I-\frac{U}{R_V}}}{\frac{U}{I-\frac{U}{R_V}}}\right|=\frac{U}{R_V I};\ \left|\frac{\Delta R}{R}\right|_{am}=\left|\frac{R_1-R}{R}\right|=\left|\frac{\frac{U}{I}-R}{R}\right|=\left|\frac{\frac{U}{I}-\frac{U-R_A I}{I}}{\frac{U-R_A I}{I}}\right|=\frac{R_A I}{U-R_A I}$$

$$\left|\frac{\Delta R}{R}\right|_{av}=\left|\frac{\Delta R}{R}\right|_{am}\Rightarrow\frac{U}{R_V I}=\frac{R_A I}{U-R_A I}\Rightarrow I^2 R_A R_V=U^2-R_A IU\Rightarrow\frac{U^2}{I^2 R_A R_V}-\frac{R_A IU}{I^2 R_A R_V}=1$$

$$\Rightarrow R_0{}^2\frac{1}{R_A R_V}=1+\frac{R_A IU}{I^2 R_A R_V}\Rightarrow R_0{}^2=R_A R_V+\frac{R_A U}{I}\Rightarrow R_0{}^2-R_A R_0-R_A R_V=0\Rightarrow$$

$$R_0=\left|\frac{-R_A\pm\sqrt{R_A{}^2-4R_A R_V}}{2}\right|\Rightarrow R_0=\frac{1}{2}(R_A+\sqrt{R_A{}^2+4R_A R_V})\Rightarrow R_0=\sqrt{R_A R_V}$$

$$R_{0,\text{ teoretic}}\approx\sqrt{R_A R_V}=\sqrt{9\cdot 200000}=\sqrt{1800000}\approx 1342\ \Omega$$

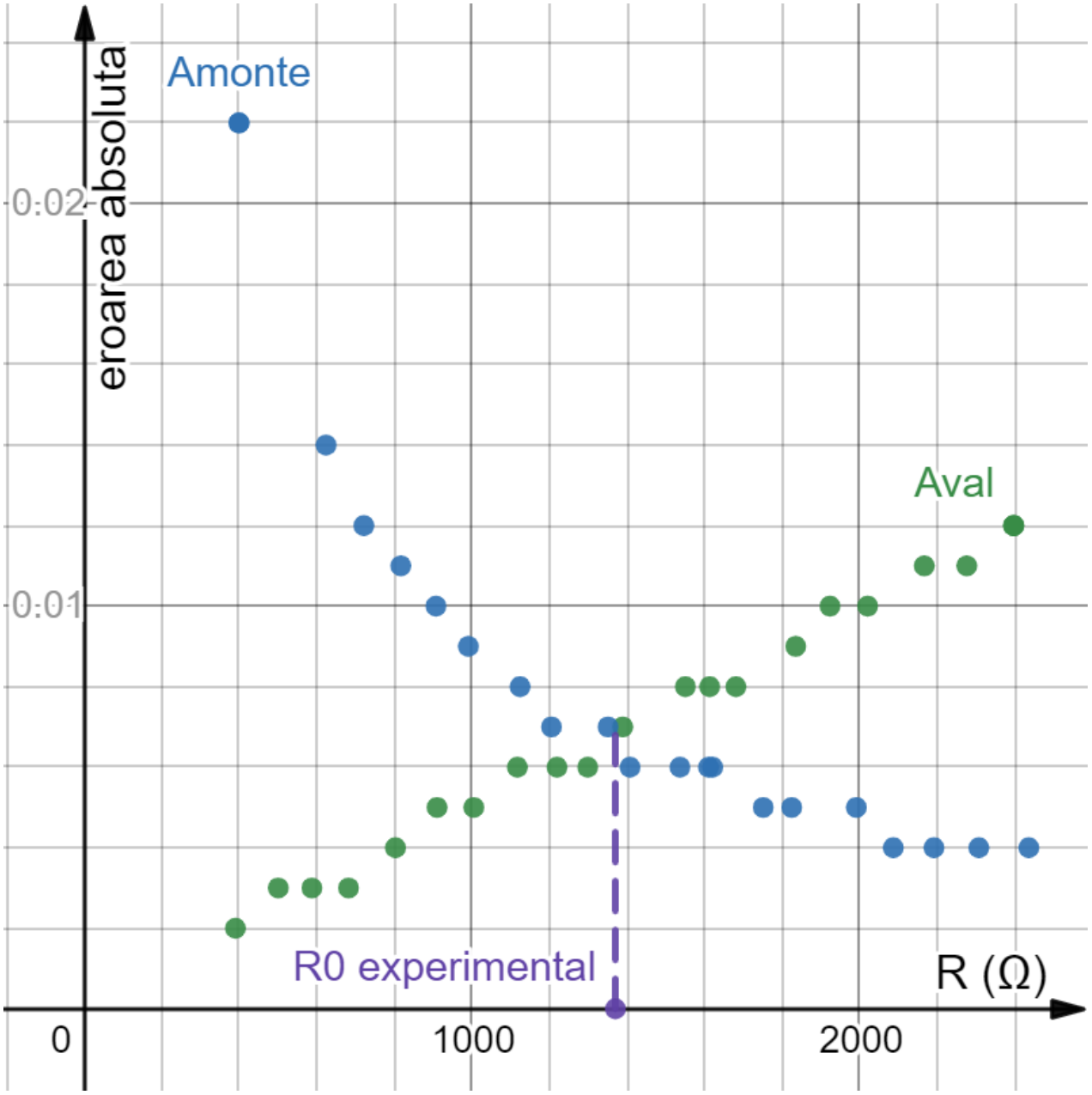
Aval

Nr Crt	U(V)	I(A)	$R_1=\frac{U}{I}(\Omega)$	$R=\frac{U}{I-\frac{U}{R_V}}(\Omega)$	$\left\|\frac{R_1-R}{R}\right\|$
1.	3.2	0.0082	390.2439	391.0068	0.002
2.	3.4	0.0068	500	501.253	0.003
3.	3.4	0.0058	586.207	587.93	0.003
4.	3.4	0.005	680	682.32	0.003
5.	5.6	0.007	800	803.213	0.004
6.	5.8	0.0064	906.25	910.375	0.005
7.	5.8	0.0058	1000	1005.025	0.005
8.	8	0.0072	1111.111	1117.318	0.006
9	8	0.0066	1212.121	1219.512	0.006
10.	8	0.0062	1290.323	1298.701	0.006

11.	8	0.0058	1379.31	1388.889	0.007
12.	8	0.0052	1538.462	1550.388	0.008
13.	8	0.005	1600	1612.903	0.008
14.	8	0.0048	1666.667	1680.672	0.008
15.	8	0.0044	1818.182	1834.862	0.009
16.	8	0.0042	1904.762	1923.077	0.01
17.	8	0.004	2000	2020.202	0.01
18.	9	0.0042	2142.857	2166.065	0.011
19.	9	0.004	2250	2275.601	0.011
20.	9	0.0038	2368.421	2396.804	0.012
21.	9	0.0038	2368.421	2396.804	0.012

Amonte

Nr Crt	U(V)	I(A)	$R_1 = \frac{U}{I}(\Omega)$	$R = \frac{U - R_A I}{I}(\Omega)$	$\left\lvert \frac{R_1 - R}{R} \right\rvert$
1.	3.6	0.0088	409.0909	400.0909	0.022
2.	3.6	0.072	50	41	0.18
3.	3.8	0.006	633.333	624.333	0.014
4.	3.8	0.0052	730.769	721.769	0.012
5.	3.8	0.0046	826.087	817.087	0.011
6.	6.6	0.0072	916.667	907.667	0.01
7.	6.6	0.0066	1000	991	0.009
8.	6.8	0.006	1133.333	1124.333	0.008
9	6.8	0.0056	1214.286	1205.286	0.007
10.	6.8	0.005	1360	1351	0.007
11.	6.8	0.0048	1416.667	1407.667	0.006
12.	6.8	0.0044	1545.455	1536.455	0.006
13.	6.8	0.0042	1619.048	1610.048	0.006
14.	8.8	0.0054	1629.63	1620.63	0.006
15.	8.8	0.005	1760	1751	0.005
16.	8.8	0.0048	1833.333	1824.333	0.005
17.	8.8	0.0044	2000	1991	0.005
18.	8.8	0.0042	2095.238	2086.238	0.004
19.	8.8	0.004	2200	2191	0.004
20.	8.8	0.0038	2315.789	2306.789	0.004
21.	8.8	0.0036	2444.444	2435.444	0.004



$R_{0,\ experimental} = 1370\ \Omega > R_{0,\ teoretic} = 1342\ \Omega$

5. Concluzii

In urma acestei lucrari de laborator am ajuns la concluzia ca daca $R < R_0$ atunci este mai buna conexiunea Aval si daca $R > R_0$ este mai buna conexiunea Amonte.