

Ruch płyt

Ćwiczenie: Wyznaczenie prędkości stacji satelitarnych
[geodynamika zaoczni]

wersja z 5 grudnia 2014





Rysunek: <http://www.ucmp.berkeley.edu/history/wegener.html>

Wykaz 1: Dane do zadania na podstawie http://itrf.ensg.ign.fr/ITRF_solutions/2008/doc/ITRF2008_GNSS.SSC.txt

	SITE NAME	X	Y	Z

1	Paris	4202777.371	171367.999	4778660.203
2	Grasse (OCA)	4581690.900	556114.836	4389360.797
3	Toulouse	4627851.828	119640.020	4372993.552
4	Brest	4231162.576	-332746.678	4745130.921
5	Chize	4427603.244	-31506.045	4575621.805
6	La Rochelle	4424632.565	-94175.229	4577544.083
7	Marseille	4630532.763	433946.308	4350142.730
8	AJACCIO	4696989.436	723994.469	4239678.545
9	Saint-Jean-des-	4433469.856	362672.821	4556211.713
10	HVITANES	2979075.679	-353362.257	5609834.842
11	Reykjavik	2587383.624	-1043032.734	5716564.496
12	Hofn	2679689.965	-727951.215	5722789.280
13	TROMSO	2102928.478	721619.454	5958196.252
14	DOMEN	1844607.287	1109719.214	5983936.149
15	STAVANGER	3275753.666	321111.042	5445042.136
16	TRONDHEIM	2820170.846	513486.054	5678936.003
17	KIRUNA	2251420.796	862817.223	5885476.713
18	KIRUNA/ESRANGE	2248123.188	865686.682	5886425.775
19	BORAS	3328984.527	761910.265	5369033.689
20	METSAHOVI	2892570.788	1311843.445	5512634.137
21	VAASA	2699864.334	1078264.009	5658064.890
22	JOENSUU	2564139.085	1486149.767	5628951.440
23	Klaipeda	3359228.136	1297490.480	5246690.347
24	GRAZ LUSTBUEHEL	4194423.817	1162702.695	4647245.414
25	Sofia	4319372.089	1868687.782	4292063.938
26	PENC	4052449.467	1417681.124	4701407.105
27	Bucarest	4093760.865	2007793.806	4445129.975
28	Pecny - Ondrejo	3979316.121	1050312.473	4857067.096
29	DUBROVNIK	4465940.064	1460594.462	4299291.412
30	Jozefoslaw - Wa	3664940.165	1409153.867	5009571.391
31	Borowiec	3738358.454	1148173.710	5021815.773
32	Borowa Gora	3633738.972	1397434.133	5035353.476
33	LAMKOWKO	3524522.920	1329693.628	5129846.342
34	Wroclaw	3835751.296	1177249.957	4941605.243

Zadanie

Literatura

35	Uzhgorod	3907587.455	1602428.695	4763783.762
36	Riga	3183899.192	1421478.489	5322810.797
37	MENDELEEVO	2844672.078	2161070.173	5266363.871
38	Irkoutsk	-968332.392	3794425.410	5018167.738
39	Kharkiv	3312984.324	2428203.433	4863307.827
40	Novossibirsk	433605.577	3655558.530	5191286.701
41	Tashkent	1695945.191	4487138.554	4190140.700
42	Yuzhno-Sakhalin	-3465320.945	2638269.371	4644085.415
43	Zwenigorod	2886335.855	2155987.574	5245818.809
44	Krasnoyarsk	-174281.918	3571333.030	5264196.041
45	Svetloe	2730155.353	1562364.734	5529989.270
46	SELEZASCHITA	1046790.610	4540257.078	4342920.786
47	YAKUTSK	-1914999.069	2308241.487	5610225.560
48	MAGADAN	-2825810.299	1581232.932	5477005.449
49	Petropavlovsk -	-3580828.469	1399698.093	5072185.152
50	GOLOSIIV - KIEV	3512888.954	2068979.881	4888903.201
51	Bishkek	1243767.185	4513678.517	4317880.340
52	Tixi Seismic st	-1264873.191	1569455.782	6031003.428
53	KHABAROVSK	-2995266.469	2990444.592	4755575.888
54	Arti	1843956.719	3016203.112	5291261.735
55	Bilibino	-2321893.075	560096.849	5894691.796
56	NORILSK	64537.191	2253782.862	5946363.499
57	Obninsk/Moscow	2936432.057	2178364.553	5208858.249
58	Lviv	3765296.991	1677559.204	4851297.409
59	NOVOSIBIRSK, SN	452288.549	3635913.142	5203396.792
60	Lampedusa	5073164.753	1134512.567	3683181.149
61	Medicina	4461400.747	919593.579	4449504.774
62	Genova	4507892.319	707621.483	4441603.515
63	Noto	4934546.226	1321265.012	3806456.123
64	Torino I	4476537.409	600431.429	4488761.333
65	CAGLIARI	4893379.972	772650.479	4004180.031
66	Matera	4641951.448	1393053.660	4133280.862
67	VENEZIA	4379724.776	957495.887	4521605.272
68	PADOVA	4389531.133	923253.791	4519256.440
69	BOLZANO	4312657.485	864634.660	4603844.443
70	Perugia	4555145.744	997822.430	4337432.738
71	BRUSSELS	4027893.747	307045.824	4919475.121
72	REDU	4091423.358	368380.588	4863179.807
73	Herstmonceux Ca	4033460.920	23537.800	4924318.255
74	NORTH SHIELDS T	3664792.063	-92117.113	5201903.820
75	Aberdeen	3466272.255	-125904.227	5334662.438

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76	TEDDINGTON	3985500.300	-23625.451	4962941.695
77	HERMITAGE	3981776.535	-89239.026	4965284.635
78	SHEERNESS	3983074.296	51683.176	4964639.794
79	Bartinney	4079953.941	-395930.245	4870196.957
80	Morpeth	3645667.836	-107277.235	5215053.530
81	SAN FERNANDO	5105519.005	-555145.872	3769803.377
82	VILLAFRANCA	4849833.695	-335049.025	4116014.939
83	Madrid-Robledo	4849202.371	-360328.967	4114913.202
84	ROQUETES - TORT	4833520.152	41537.108	4147461.549
85	Yebes	4848724.704	-261632.206	4123094.153
86	BELLMUNT DE SEG	4775849.397	116814.368	4213018.970
87	Cap de Creus	4715420.300	273177.788	4271946.702
88	Alicante	5009051.187	-42072.192	3935057.740
89	A Coruna	4594489.710	-678367.774	4357066.133
90	Almeria	5105220.093	-219278.521	3804387.130
91	CANTABRIA	4625924.478	-307096.516	4365771.399
92	VALENCIA	4929533.829	-29050.408	4033710.161
93	Palma de Mallor	4919369.466	225499.854	4039849.833
94	Ceuta	5150601.792	-478834.385	3718884.864
95	KOOTWIJK	3899225.130	396731.939	5015078.427
96	WESTERBORK	3828735.863	443304.957	5064884.712
97	EIJSDEN	4023086.268	400395.097	4916655.543

$$\frac{d\varphi}{dt} = \Omega \cdot \cos \Phi \cdot \sin(\lambda - \Lambda)$$

$$\frac{d\lambda}{dt} = \Omega \cdot [\sin \Phi - \cos(\lambda - \Lambda) \cdot \operatorname{tg} \varphi \cos \Phi]$$

$$\Omega = 0.2337^\circ / 10^6 \text{ lat},$$

$$\Lambda = 247.725^\circ,$$

$$\Phi = 50.631^\circ$$

$$V_X = \omega_Y Z - \omega_Z Y$$

$$V_Y = \omega_Z X - \omega_X Z$$

$$V_Z = \omega_X Y - \omega_Y X$$

$$\omega_X = -0.000981,$$

$$\omega_Y = -0.002395,$$

$$\omega_Z = 0.003153 \text{ [rad}/10^6 \text{ lat]}$$

Dla swoich danych proszę policzyć prędkości stacji w układzie geocentrycznym i lokalnym (wrazić je w [m/rok]).

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$$V_{enu} = A^T \cdot V_{xyz}$$

$$\begin{bmatrix} V_e \\ V_n \\ V_u \end{bmatrix} = \begin{bmatrix} -\sin \lambda & \cos \lambda & 0 \\ -\sin \varphi \cos \lambda & -\sin \varphi \sin \lambda & \cos \varphi \\ \cos \varphi \cos \lambda & \cos \varphi \sin \lambda & \sin \varphi \end{bmatrix} \cdot \begin{bmatrix} V_x \\ V_y \\ V_z \end{bmatrix}$$

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$$V_{enu} = A^T \cdot V_{xyz}$$

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- Na kuli $R = 6\,371\,000$ m.

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$$V_{enu} = A^T \cdot V_{xyz}$$

$$\begin{bmatrix} V_e \\ V_n \\ V_u \end{bmatrix} = \begin{bmatrix} -\sin \lambda & \cos \lambda & 0 \\ -\sin \varphi \cos \lambda & -\sin \varphi \sin \lambda & \cos \varphi \\ \cos \varphi \cos \lambda & \cos \varphi \sin \lambda & \sin \varphi \end{bmatrix} \cdot \begin{bmatrix} V_x \\ V_y \\ V_z \end{bmatrix}$$

- Na kuli $R = 6\,371\,000$ m.
- Dodatkowe (nieobowiązkowe): i na kuli i na elipsoidzie systemu WGS84 i porównać wyniki.



O modelach ruchu płyt. URL: <http://www.ucmp.berkeley.edu/geology/tectonics.html>.



UNAVCO *plate motion calculator.* URL: http://www.unavco.org/community_science/science-support/crustal_motion/dxdt/model.html.