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Prepared by
K. A. Berteussen

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J. SOME AUTOREGRESSIVE MODELS FOR SHORT-PERIOD SEISMIC NOISE

Several investigations have been made into the structure of seismic noise in general and of the seismic noise at NORSAR in particular. These studies have been nonparametric in nature in the sense that they have been concerned with the general properties of the spectrum and autocorrelation function of the process. The advantage of having a parametric model should be obvious. If a good model can be found, the noise process can be characterized by the numerical values of a few parameters as opposed to a study of plots of the spectrum and the autocorrelation function.

It turns out that the short-period seismic noise at NORSAR can be described by a parametric model having the form

$$X(t) - a_1(t)X(t-1) - \dots - a_p(t)X(t-p) = Z(t)$$

where $X(t)$ is used to denote the noise process. This is a nonstationary generalization of the standard autoregressive models allowing time-varying autoregressive coefficients and a nonstationary white-noise residual process $Z(t)$. It is found that the short-period noise at NORSAR is in most cases quite satisfactorily described by a third order ($p=3$) model. Also, it is seen from Table J.1 that the nonstationary character of the noise is due primarily to time variations of the residual variance and the lower order autoregressive coefficients.

D. Tjøstheim

REFERENCE

Tjøstheim, D. (1975): Some autoregressive models for short-period seismic noise, Bull. Seism. Soc. Am., 65, pp. 677-691.

TABLE J.1

Mean, standard deviation and stability parameters of autoregressive coefficients and residual variances for various subarrays. The parameters are obtained by averaging the estimated autoregressive coefficients and residual variances over 34 two-minute noise samples from August 1973. For each two-minute sample a third order autoregressive model has been assumed. The stability parameter gives an indication of the time variations in the model. Low stability means large time variations and vice versa.

Sub-array	$\hat{a}_{31}$			$\hat{a}_{32}$			$\hat{a}_{33}$			$\hat{\sigma}_z^2$		
	Mean	St.Dev.	Stab.	Mean	St.Dev.	Stab.	Mean	St.Dev.	Stab.	Mean	St.Dev.	Stab.
01A	1.68	0.15	11.2	-0.97	0.28	3.5	0.18	0.15	1.2	16323	10584	1.6
01B	1.79	0.13	13.8	-1.01	0.28	3.6	0.15	0.16	0.9	10785	6352	1.7
02B	1.80	0.10	18.0	-1.09	0.20	5.5	0.20	0.10	2.0	9203	4665	2.0
03B	1.63	0.19	8.6	-0.82	0.36	2.3	0.09	0.18	0.5	21438	14072	1.5
05B	1.70	0.17	10.0	-0.95	0.32	2.9	0.14	0.16	0.9	12240	9426	1.3
06B	1.70	0.12	14.2	-0.92	0.22	4.2	0.11	0.12	0.9	10185	6158	1.6
07B	1.73	0.22	7.9	-1.00	0.30	3.3	0.17	0.13	1.3	13402	12839	1.0
01C	1.73	0.10	17.3	-1.00	0.20	5.0	0.18	0.11	1.6	8135	3522	1.3
02C	1.71	0.11	16.5	-0.93	0.28	3.3	0.12	0.15	0.8	9246	5127	1.8
03C	1.64	0.22	7.5	-0.83	0.39	2.1	0.09	0.17	0.5	11633	11273	1.0
04C	1.60	0.19	8.4	-0.74	0.38	1.9	0.04	0.17	0.2	9837	8865	1.1
05C	1.73	0.23	7.5	-0.95	0.37	2.6	0.16	0.17	0.9	10436	8135	1.3
06C	1.72	0.13	13.2	-0.94	0.26	3.6	0.13	0.14	0.9	8457	5656	1.5
07C	1.54	0.18	8.6	-0.68	0.29	2.3	0.02	0.13	0.2	11666	8685	1.3
09C	1.42	0.34	3.9	-0.57	0.47	1.2	-0.00	0.20	0.0	21412	26591	0.8
10C	1.76	0.11	16.0	-1.02	0.17	6.0	0.17	0.10	1.7	10415	6655	1.7
11C	1.72	0.09	19.1	-0.95	0.18	5.3	0.12	0.11	1.1	17061	10639	1.6
12C	1.75	0.13	13.5	-1.00	0.23	4.3	0.14	0.12	1.2	9942	5412	1.8
13C	1.53	0.18	8.4	-0.56	0.25	2.2	-0.08	0.14	0.6	12779	12013	1.0
14C	1.43	0.30	4.8	-0.65	0.35	1.9	0.08	0.14	0.6	23544	8942	2.6