

Bibliography of Self-Organizing Map (SOM) Papers: 1981–1997

Samuel Kaski[†], Jari Kangas[‡], Teuvo Kohonen[†]

[†] Helsinki University of Technology, Neural Networks Research Centre,
P.O. Box 2200, FIN-02015 HUT, FINLAND

[‡] Nokia Research Center, P.O. Box 100, FIN-33721 Tampere, FINLAND

Abstract

The Self-Organizing Map (SOM) algorithm has attracted an ever increasing amount of interest among researchers and practitioners in a wide variety of fields. The SOM and a variant of it, the LVQ, have been analyzed extensively, a number of variants of them have been developed and, perhaps most notably, they have been applied extensively within fields ranging from engineering sciences to medicine, biology, and economics. We have collected a comprehensive list of 3343 scientific papers that use the algorithms, have benefited from them, or contain analyses of them. The list is intended to serve as a source for literature surveys. We have provided both a thematic and a keyword index to help finding articles of interest.

1 INTRODUCTION

The Self-Organizing Map algorithm [1530, 1537, 1593] was introduced in 1981. The earliest applications were mainly in engineering tasks. Later the algorithm has become progressively more accepted as a standard data analysis method in a wide variety of fields that can utilize unsupervised learning: clustering, visualization, data organization, characterization, and exploration. The variant called Learning Vector Quantization (LVQ) has additionally been used extensively in supervised tasks, especially classification and supervised pattern recognition.

Many of the papers on SOM analyze the method or present variants or generalizations of it. Most of the papers, however, apply the method or its variants in fields ranging from engineering (including image and signal processing and recognition, telecommunications, process monitoring and control, and robotics) and natural sciences to medicine, humanities, economics and mathematics. The definitive reference to the state of the art in SOMs is [1593].

1.1 Collection Method

We have been collecting a bibliography of scientific papers on SOM already for many years. Our criterion in selecting papers has been that they should either use or analyze the SOM, or benefit from it in some other manner. Our intention has been to exclude papers that merely refer to the algorithm.

Several methods have been used in collecting the bibliography. We have added references to papers that have appeared in the journals and conference proceedings that we personally follow. In addition, several authors have kindly helped us by sending us bibliographies on their own papers. Finally, we have made searches in commonly used bibliographic databases.

We intend to maintain the bibliography in the future. New entries will be included as attachments in this paper. Additionally, the entries will be available in BibTeX format at the WWW address

⁰This work has been supported by the Academy of Finland. Updates, corrections, and comments should be sent to Samuel Kaski at biblio@mail.cis.hut.fi.

<http://www.cis.hut.fi/nncr/refs/>. Additions to the list and error reports are most welcome; please send any correspondence to the email address biblio@mail.cis.hut.fi.

1.2 Advice on Using the Bibliography

We have constructed indices to aid in exploring the vast bibliography. Unfortunately it would have been infeasible to compile manually a complete index of the whole collection of papers, and we have therefore constructed two different kinds of indices.

The first index is thematically organized, and it contains references to manually selected papers. Therefore, all of the papers that have been listed will probably be useful, but all the possibly relevant papers will not occur in the index. Some hints of index terms that might lead to additional papers have been provided.

We have also constructed a keyword index. The papers were chosen mostly automatically based on the words that appear in their titles, and therefore the index cannot be as well-organized as a manually generated one. For example, all of the papers that treat speech recognition cannot be found using the index entry "speech". On the other hand, some index terms may contain references to several kinds of papers. For example, it may be clear that all of the papers that contain the word "growing" do not analyze growing SOMs. We recommend using several keywords and to utilize the thematic index in finding suitable keywords.

Despite the problems mentioned above we felt that it was important to make every possible clue of useful information available; it would be a totally infeasible task to browse through the complete list of 3343 papers when searching for papers on a specific topic. In fact, almost all (2916 out of 3343) of the papers have been referred to in either of the indices. We hope that the combination of the thematic index, the keyword index, and keyword searches in the Web version of this paper will aid in the difficult task of finding useful information among the large collection of SOM papers.

ACKNOWLEDGMENTS

The authors thank Mr. Marko Malmberg, Mr. Sami Nousiainen and Mr. Antti Saarela for help in conducting database searches.

2 THEMATIC INDEX

2.1 General

- Books and review articles
[582, 1543, 1571, 2081, 2269, 2498]
- Program packages
[1510, 1511]
Index term: program package

2.2 Status of the Mathematical Analyses

- Attempts for constructive proofs
[1521, 1534]
- Markov-process proofs
[293, 294, 297, 298, 299, 574, 756, 757, 825, 1535, 2856]
- Energy-function formalisms
[756, 1160, 1898, 2891]

- Bayesian error method

[1902]

- Higher-dimensional input and array

[2498]

Index term: high-dimensional SOM

- Most recent analyses

[324, 584, 641, 647, 717, 718, 808, 830, 831, 903, 1145, 1378, 2086, 2088, 2608, 2745, 2813, 2816, 3009, 3251, 3252, 3329]

2.3 Survey of General Aspects of the SOM

2.3.1 General Papers on SOM

[21, 24, 32, 33, 54, 77, 82, 134, 137, 143, 194, 226, 254, 304, 323, 360, 381, 382, 411, 438, 537, 544, 583, 585, 604, 632, 645, 649, 662, 663, 668, 722, 733, 734, 741, 752, 754, 762, 763, 796, 807, 816, 818, 822, 827, 828, 860, 875, 902, 906, 927, 931, 1109, 1131, 1150, 1153, 1154, 1155, 1156, 1157, 1158, 1161, 1174, 1181, 1182, 1191, 1218, 1233, 1263, 1324, 1336, 1337, 1342, 1348, 1356, 1375, 1380, 1438, 1442, 1458, 1462, 1467, 1516, 1517, 1519, 1520, 1521, 1530, 1532, 1533, 1534, 1535, 1536, 1537, 1538, 1539, 1540, 1541, 1542, 1543, 1544, 1545, 1546, 1547, 1548, 1550, 1551, 1552, 1553, 1554, 1555, 1556, 1558, 1561, 1562, 1565, 1568, 1569, 1570, 1572, 1573, 1574, 1575, 1578, 1587, 1588, 1590, 1614, 1625, 1645, 1648, 1674, 1708, 1715, 1726, 1735, 1741, 1799, 1819, 1820, 1821, 1822, 1829, 1850, 1854, 1869, 1874, 1876, 1878, 1917, 1923, 1983, 1984, 1997, 2016, 2059, 2071, 2073, 2105, 2118, 2142, 2268, 2275, 2276, 2314, 2333, 2343, 2494, 2498, 2499, 2503, 2505, 2516, 2517, 2522, 2533, 2535, 2580, 2589, 2608, 2632, 2692, 2744, 2796, 2844, 2857, 2884, 2915, 2920, 2928, 3001, 3002, 3035, 3036, 3055, 3214, 3246, 3267, 3293, 3320]

2.3.2 Mathematical Derivations, Analyses, and Modifications of the SOM

- Derivations

[172, 173, 225, 302, 303, 337, 338, 555, 643, 786, 790, 836, 929, 994, 1036, 1079, 1623, 1624, 1814, 1816, 1870, 1871, 1888, 1893, 1901, 1902, 1982, 2001, 2307, 2369, 2395, 2398, 2488, 2557, 2814, 2891, 2925, 2926, 2927, 2993, 3238, 3339]

- Convergence proofs

[293, 294, 295, 296, 297, 298, 299, 574, 578, 584, 591, 593, 650, 757, 758, 825, 827, 828, 840, 1036, 1152, 1159, 1160, 1208, 1246, 1578, 1667, 1873, 1875, 1877, 2515, 2779, 3236, 3255, 3308]

Index term: convergence

- Accelerated convergence

[53, 1036, 1246, 1276, 1277, 1424, 1578, 1717, 1720, 2322, 2323, 2324, 2389, 2843, 3132, 3255]

Index term: convergence

- Multistage, multilevel, and hierarchical SOMs

[49, 51, 132, 313, 314, 461, 499, 926, 1000, 1095, 1096, 1098, 1232, 1245, 1253, 1255, 1291, 1325, 1326, 1426, 1609, 1612, 1620, 1716, 1721, 1739, 1825, 1844, 1851, 1887, 1888, 1890, 1891, 1892, 1896, 1897, 2509, 2518, 3122, 3126, 3137, 3138, 3219, 3262]

Index terms: hierarchical, hypermap, multilayer SOM, tree

- Growing SOM structures
[162, 257, 258, 506, 850, 851, 852, 854, 855, 858, 859, 861, 862, 2527, 2528, 2579, 2793, 2794, 2795, 2796, 3154]
Index term: growing
- SOM for sequential inputs
[444, 1246, 1361, 1362, 1363, 1364, 1366, 1718, 2433, 2587, 2890, 3288]
Index terms: adaptive-subspace SOM, ASSOM, invariant, sequence, temporal, time-series
- Fuzzy SOM and LVQ
[233, 528, 529, 1764, 2484, 2582, 2583, 2780, 2781, 2933, 2934, 2936, 3227, 3228, 3230]
Index terms: fuzzy, fuzzy SOM
- Supervised SOM
[188, 467, 1217, 1219, 1253, 1518, 1896, 1899, 1900, 2069]
- Miscellaneous structural variants
[84, 179, 389, 425, 500, 856, 875, 879, 880, 2437, 3087, 3233]
Index terms: hypercube, PSOM, splitting, tree
- Miscellaneous functional variants
[28, 414, 558, 573, 829, 974, 975, 1037, 1143, 1247, 1322, 1486, 1497, 2399, 2434, 2537, 2803, 2825, 2858, 2953, 2994, 3006]
Index terms: batch, interpolation
- Other modifications and generalizations
[160, 207, 234, 261, 330, 332, 333, 400, 401, 406, 409, 478, 479, 480, 481, 482, 483, 557, 653, 669, 971, 1048, 1170, 1183, 1185, 1186, 1187, 1189, 1287, 1288, 1311, 1312, 1313, 1336, 1350, 1353, 1380, 1584, 1586, 1588, 1648, 1669, 1675, 1846, 1975, 1980, 1981, 1983, 1984, 1993, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2298, 2311, 2504, 2521, 2702, 2703, 2704, 2705, 2746, 2908, 2909, 2910, 2911, 2912, 2937, 3096, 3105, 3162, 3202, 3211, 3212, 3213, 3260]
Index terms: annealing, GTM, hypermap, probabilistic, pruning, recurrent, simulated annealing
- Benchmarkings
[159, 161, 263, 275, 713, 714, 1014, 1047, 1234, 1235, 1236, 1879, 1889, 1894, 1898, 2011, 2370, 2397, 2413, 2501, 2502, 2828, 3115, 3186, 3194, 3195]
Index term: benchmark

2.3.3 Hybridization of the SOM with Other Neural Networks

[81, 147, 698, 1225, 1452, 1637, 2065, 2262, 2463]

Index terms: ARTMAP, backpropagation, cascade-correlation, counterpropagation, feedforward, fuzzy, genetic, evolution, hybrid, MLP, multilayer perceptron, perceptron, RBF

2.4 Modifications and Analyses of LVQ

[24, 73, 152, 153, 154, 160, 224, 228, 229, 233, 255, 256, 344, 352, 366, 528, 529, 672, 681, 928, 930, 932, 933, 934, 1283, 1285, 1286, 1414, 1415, 1425, 1453, 1454, 1481, 1496, 1626, 1649, 1652, 1680, 1681, 1682, 1683, 1684, 1706, 1709, 1736, 1760, 1871, 1872, 1924, 1925, 1926, 1927, 1957, 1958, 2097, 2098, 2112, 2113, 2174, 2402, 2403, 2404, 2424, 2425, 2462, 2488, 2489, 2490, 2582, 2583, 2599, 2600, 2727, 2774, 2799, 2867, 2881, 2933, 2934, 2936, 2937, 2952, 2972, 3025, 3026, 3048, 3106, 3154, 3199, 3207, 3208, 3227, 3228, 3230, 3271, 3273, 3295, 3320, 3322, 3323]

2.5 Survey of Diverse Applications

2.5.1 Machine Vision and Image Analysis

- General

[23, 191, 194, 195, 472, 1022, 1641, 2219, 2275, 2277, 2836, 2847, 2848, 2936, 3056, 3120, 3121, 3123]

Index terms: computer vision, image, vision, visual

- Image coding and compression

[94, 95, 129, 336, 339, 372, 376, 422, 468, 471, 496, 520, 565, 622, 949, 954, 1335, 1428, 1468, 1499, 1665, 1672, 1673, 1743, 1744, 1833, 1892, 1904, 2011, 2186, 2187, 2188, 2233, 2652, 2684, 3101, 3216, 3218, 3220, 3221]

Index terms: compression, image coding, image compression, Hough transform

- Image segmentation

[100, 144, 410, 678, 723, 799, 935, 937, 1003, 1075, 1468, 1609, 1809, 1906, 1922, 2192, 2253, 2254, 2444, 2696, 2697, 2812, 2977, 3043, 3045, 3046, 3047, 3049, 3050, 3051, 3053, 3054, 3058, 3059, 3061, 3257]

Index terms: segmentation, texture segmentation, texture

- Satellite images and data

[1451, 1695, 3078, 3179]

Index terms: cloud (classification), Landsat, satellite

- Miscellaneous tasks in machine vision

[50, 52, 65, 66, 83, 85, 87, 112, 275, 289, 375, 398, 460, 623, 706, 915, 916, 939, 940, 960, 1067, 1105, 1110, 1138, 1184, 1216, 1236, 1264, 1300, 1320, 1321, 1365, 1367, 1370, 1396, 1418, 1644, 1712, 1719, 1723, 1724, 1818, 1848, 1860, 1867, 1880, 1881, 1883, 1895, 1899, 1919, 1972, 1973, 2057, 2058, 2138, 2144, 2159, 2173, 2266, 2274, 2289, 2290, 2324, 2373, 2475, 2521, 2534, 2597, 2696, 2697, 2808, 2839, 2922, 2923, 2934, 3023, 3044, 3045, 3052, 3057, 3122, 3126, 3178, 3210, 3211, 3217]

Index terms: binocular, cloud classification, color, edge, face, fingerprint, multispectral, multiscale image, texture, texture analysis, video

- Medical imaging and analysis

[103, 221, 531, 896, 1328, 1935, 2331, 2351, 2946, 2948, 2949, 3020]

Index terms: brain, cortex, EEG, magnetoencephalographic, magnetic resonance image, medical image, PET

2.5.2 Optical Character and Script Reading

[72, 110, 116, 189, 501, 505, 545, 946, 1106, 1132, 1133, 1257, 1288, 1441, 1473, 1752, 1816, 1827, 1858, 2121, 2122, 2123, 2125, 2130, 2137, 2182, 2191, 2334, 2644, 2840, 2986, 3197, 3231, 3232]

Index terms: character (recognition), digit recognition, handwritten, optical, script

2.5.3 Speech Analysis and Recognition

- General

[158, 200, 201, 312, 367, 397, 600, 665, 695, 751, 1017, 1084, 1137, 1167, 1168, 1238, 1303, 1359, 1363, 1426, 1464, 1494, 1495, 1813, 1861, 2000, 2112, 2113, 2332, 2472, 2712, 2771, 2869, 2879, 2895, 2899, 2905, 2973, 3320, 3322, 3323]

Index terms: cepstrum, continuous density Markov model, (mixture) density HMMs, language, LPC, speech, speaker, typewriter

- Isolated-word recognition

[364, 495, 1228, 1301, 1430, 1433, 1740]

Index term: word recognition

- Connected-word and continuous-speech recognition

[58, 67, 68, 70, 465, 598, 601, 606, 1059, 1313, 1354, 1355, 1358, 1360, 1362, 1399, 1431, 1432, 1456, 1465, 1490, 1518, 1527, 1529, 1531, 1535, 1560, 1564, 1566, 1579, 1582, 1626, 1628, 1629, 1630, 1926, 1927, 2070, 2488, 2489, 2490, 3201]

- Speaker identification

[550, 552, 1032, 1314, 2179, 2200, 2201]

Index term: speaker identification

- Phonetic research

[39, 167, 223, 279, 436, 540, 654, 1172, 1357, 1372, 1457, 1769, 1771, 1772, 1773, 1774, 1776, 1777, 1779, 2147, 2469, 2482, 2483, 2880, 2971, 3016]

Index terms: articulation, coarticulation, cochlear, consonant, dysphonia, misarticulation, phoneme, phonetic, vowel

2.5.4 Acoustic and Musical Studies

[359, 950, 1136, 1415, 1742, 1783, 1915, 2864]

Index terms: acoustic, auditory, music, pitch, timbre, voice

2.5.5 Signal Processing and Radar Measurements

[25, 602, 801, 1074, 1429, 1477, 1952, 2645, 2753, 2754, 2755, 3158]

Index terms: antenna, DSP, FFT, radar, signal processing, signal recognition, signal representation, sonar, ultrasonic

2.5.6 Telecommunications

[91, 93, 169, 301, 378, 795, 844, 845, 847, 848, 849, 1031, 1039, 1369, 1478, 1492, 1522, 1523, 1524, 1525, 1725, 2199, 2367, 2455, 2457, 2458, 2459, 2713, 2714, 2715, 2716]

Index terms: antenna, ATM, CDMA, cellular, equalization, mobile communication, modulation, QAM, telecommunications, transmission

2.5.7 Industrial and Other Real-world Measurements

[18, 34, 115, 164, 613, 912, 913, 1081, 1437, 1784, 1942, 2003, 2114, 2540, 2606, 2695, 2877, 2938, 2990, 3004, 3005, 3039, 3160, 3245, 3302]

Index terms: condition monitoring, corrosion, elevator, engine, fabric, fault diagnosis, fermentation, furnace, fusion, industrial, load forecasting, odor, plant diagnostic, power plant, power system, sensor, system identification, traffic

2.5.8 Process Control

[35, 36, 132, 140, 185, 198, 342, 343, 353, 354, 355, 535, 570, 596, 802, 804, 837, 885, 890, 907, 918, 988, 992, 1009, 1222, 1246, 1319, 1400, 1413, 1434, 1639, 1714, 1798, 1910, 2102, 2109, 2133, 2134, 2153, 2209, 2213, 2214, 2215, 2216, 2217, 2249, 2255, 2616, 2617, 2717, 2741, 2742, 2743, 2772, 2921, 2924, 2958, 3043, 3069, 3198, 3228, 3229, 3230, 3262, 3278, 3312]

Index terms: adaptive control, control, fuzzy diagnosis, fuzzy controller, load forecasting, neurocontrol, plant diagnostic, process control, visualization

2.5.9 Robotics

- General

[139, 328, 386, 387, 621, 636, 839, 1000, 1102, 1108, 1493, 1710, 1830, 1987, 2027, 2120, 2497, 2659, 2718, 2987, 3027]

Index terms: animat, autonomous, robot

- Robot arm

[998, 1164, 1175, 1327, 1445, 1976, 1978, 1979, 1981, 1985, 1986, 2500, 2511, 2512, 2514, 3085, 3088]

Index term: visuomotor

- Robot navigation

[131, 133, 136, 306, 307, 308, 542, 997, 1103, 1104, 1107, 1112, 1291, 1292, 1663, 1884, 2128, 2204, 2205, 2206, 2207, 2342, 2519, 2718, 2832, 2917, 3017, 3022, 3063, 3082, 3337]

Index terms: mobile robot, navigation, obstacle avoidance

2.5.10 Chemistry

[75, 242, 781, 782, 783, 784, 785, 787, 788, 789, 910, 964, 965, 966, 2028, 2030, 2031, 2032, 2947, 3294]

Index terms: chemical, chemistry, chromosome, lipid, mass spectrometry, polymer, protein

2.5.11 Physics

[484, 592, 1299, 1450, 2007, 2008, 2024, 2453, 2605, 2910, 2911, 2912]

Index terms: geophysical, gluon, hadronic, infrared, laser, particle, plasma, seismic

2.5.12 Electronic-circuit Design

[383, 409, 412, 549, 1124, 1125, 1126, 1127, 1128, 1289, 1311, 1312, 1472, 1487, 1968, 2092, 2443, 2573, 2588, 2617, 2677, 2678, 2679, 2680, 2807, 2929, 3241, 3285, 3287, 3298, 3299, 3301, 3303, 3304]

Index terms: cell-placement, chip, circuit placement, floorplan design, placement, VLSI, VLSI placement

2.5.13 Medical Applications Without Image Processing

[261, 262, 282, 309, 553, 554, 617, 708, 738, 739, 948, 1002, 1080, 1244, 1307, 1347, 1402, 1503, 1805, 1840, 2116, 2117, 2139, 2239, 2246, 2364, 2416, 2426, 2523, 2524, 2525, 2526, 2532, 2611, 2767, 2786, 3000, 3145]

Index terms: anaemia, anaesthesia, arrhythmia, artery disease, autism, benzodiazepine, biomedical, cancer, clinical, diabetes, diagnostic, disease, disorder, ECG, EEG, EMG, epilepsy, event-related (evoked) potential, MEG, Parkinson, sleep

2.5.14 Data Processing

[104, 105, 125, 227, 243, 245, 264, 326, 361, 371, 388, 624, 631, 901, 926, 927, 1020, 1120, 1201, 1969, 1990, 1995, 2040, 2041, 2042, 2044, 2046, 2145, 2493, 2670, 2675, 2954, 2955, 2957, 2964, 2965, 2970, 3007, 3008, 3021, 3171, 3315]

Index terms: accounting, bank, bankruptcy, customer, data exploration, data mining, database, economic, exploration, financial, security, information retrieval, multidimensional scaling, projection pursuit, statistics, visualization

2.5.15 Linguistic and AI Problems

Index terms: AI, context, corpus, digital libraries, document, grammar, indexing, information retrieval, language, lexical, library, linguistic, LSI, natural language, semantic, sentence, text, thesauri, WEBSOM

- Lexica

[2081, 2124, 3080, 3177]

- Categories
[800, 1129, 2336, 2337, 2495, 2496, 2510, 2627, 2631, 2655, 2656]
- Expressions and sentences
[1183, 1202, 1203, 2072, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2357, 2619, 2620, 2636, 2640, 2641, 2642]
- Full-text analysis
[2618, 2622, 2623, 2624, 2625, 2626, 2629, 2630, 2633, 2634, 2635, 2637, 2639]
- Knowledge acquisition
[458, 543, 1203, 1507, 1675, 2654, 2875, 2956, 2962, 2963]
- Information retrieval
[1811, 2628, 2632]
- Further linguistic studies.
[437, 857, 1964, 2621, 3173]

2.5.16 Mathematical Problems

[40, 56, 57, 60, 171, 205, 244, 331, 332, 461, 479, 480, 481, 482, 483, 576, 577, 635, 671, 673, 696, 750, 838, 866, 867, 869, 871, 875, 921, 993, 1046, 1049, 1064, 1135, 1163, 1190, 1251, 1330, 1331, 1419, 1439, 1491, 1535, 1642, 1656, 1685, 1713, 1886, 1905, 1975, 1999, 2022, 2150, 2151, 2162, 2163, 2164, 2165, 2172, 2259, 2260, 2284, 2330, 2375, 2431, 2432, 2549, 2550, 2594, 2596, 2651, 2720, 2724, 2815, 2817, 2841, 2931, 3018, 3086, 3114, 3311]

Index terms: chaos, density, density estimation, (mixture) density HMMs, dynamic programming, finite-element, hidden Markov models, kernel, optimization, regression, smoothing

- The traveling-salesman problem
[1, 64, 86, 325, 327, 345, 516, 743, 772, 834, 858, 873, 920, 957, 1220, 1222, 1229, 1758, 2818, 2826, 2888]
Index term: traveling salesman problem (TSP)
- Fuzzy logic and SOM
[217, 334, 759, 1282, 1440]
Index terms: fuzzy, fuzzy clustering, fuzzy controller, fuzzy learning, fuzzy SOM

2.5.17 Neurophysiological Research

[181, 283, 313, 619, 951, 1008, 1484, 1589, 1880, 1977, 2126, 2236, 2238, 2240, 2241, 2244, 2245, 2247, 2248, 2382, 2383, 2385, 2411, 2568, 2603, 2787, 2789, 2992, 3155]

Index terms: brain, cortex, EEG, event-related (evoked) potential, MEG, physiological, sleep

2.5.18 Miscellaneous Applications

[868, 870, 881, 888, 1165, 1856, 1882, 1921, 2168, 2647, 2648, 2919]

Index terms: asteroid, astronomy, beer, insect courtship, environmental, galaxy, oceanographic

2.6 Applications of LVQ

- Image analysis and OCR
[666, 1141, 1627, 1652, 1732, 1920, 1946, 1947, 1948, 1949, 2769, 2878, 2933, 2934, 3046, 3047, 3049, 3050, 3051, 3061]
- Speech analysis and recognition
[55, 212, 213, 214, 215, 314, 384, 463, 667, 716, 1285, 1286, 1414, 1415, 1453, 1460, 1633, 1634, 1640, 1680, 1681, 1682, 1683, 1684, 1686, 1696, 1925, 1926, 1927, 1956, 1957, 1958, 2012, 2013, 2014, 2097, 2174, 2175, 2190, 2278, 2404, 2462, 2488, 2489, 2490, 2609, 2882, 2972, 2973, 3093, 3190, 3281, 3320, 3322, 3323, 3334]
- Signal processing and radar
[26, 602, 814, 815, 817, 877, 2143]
- Industrial and real-world measurements and robotics
[31, 170, 1334, 1694, 2581, 3226, 3227]
- Mathematical problems
[2536, 2723, 2886, 3064, 3271]

2.7 Survey of SOM and LVQ Implementations

Index terms: software, hardware

- Software packages
[485, 1512, 1618, 1619, 1621, 1826, 3157]
Index terms: program package, simulator, software
- Programming SOM on parallel computers
[111, 117, 265, 292, 556, 637, 638, 709, 909, 1055, 1179, 1617, 1638, 1761, 1762, 1766, 1783, 1920, 1953, 1955, 2237, 2242, 2243, 2691, 2699, 2883, 2964, 2965, 3159, 3189, 3204]
Index terms: CNAPS, hypercube, parallel implementation, SIMD, transputer
- Analog SOM architectures
[530, 1116, 1117, 1677, 1907, 1908, 1911, 1950, 1991, 2305, 2564, 2681, 3062, 3130, 3281]
Index terms: analog, analog VLSI, optical
- Digital SOM architectures
[48, 101, 155, 572, 620, 659, 726, 765, 944, 945, 946, 947, 983, 984, 985, 987, 989, 991, 1180, 1581, 1585, 1650, 1651, 1765, 1797, 2005, 2006, 2227, 2228, 2282, 2361, 2362, 2363, 2560, 2562, 2569, 2570, 2747, 2748, 2749, 2750, 2751, 2752, 2893, 2894, 2930, 2989, 3041, 3074]
Index terms: COKOS, coprocessor
- Analog-digital SOM architecture
[2360]
- Digital chips for SOM
[19, 76, 507, 1169, 1177, 1178, 1258, 1951, 2025, 2361, 2363, 2983, 2985]
Index terms: chip, CMOS, integrated circuit, VLSI, wafer scale

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- accounting [126, 2670]
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