應用基因演算法於求解模糊環境下之單元製造系統問題

李師尹、白炳豐

E-mail: 9127157@mail.dyu.edu.tw

摘 要

單元製造系統，為群組技術(Group Technology)之應用，近十年來由於其可簡化生產流程、縮短整備時間、降低物料處理，減少品質問題等優點，可以有效地降低成本，因此廣泛的受到專家學者的研究與探討。由於單元製造系統問題具有NP-Complete特性，一般皆以啟發式演算法求得近似最佳解，以期在可接受的時間內求得最佳解。 本研究欲將工件或機器因加工技術性或幾何特性而不能明確區分於某一單元之特性，應用模糊理論對於不確定因素之推理能力加以釐清。而基因演算法是一種模擬生物演進過程的最佳化方法，被廣泛的運用於自然科學及人工智慧等領域，用以搜尋一問題或函數之近似最佳解，透過一些擬生物化的人工運算過程進行演化，衍生出問題之近似最佳解。故欲設計出一套模糊基因演算法已解決群組問題，並與先前研究以相同之績效指標相比較。

關鍵詞 : 群組技術、單元形成、模糊理論、基因演算法

目錄

參考文獻

[1]ABDELMOLA, A. I. AND S. M. TABOUN, 1999, "PRODUCTIVITY MODEL FOR THE CELL FORMATION PROBLEM: A SIMULATED ANNEALING ALGORITHM," COMPUTERS IND. ENGNG., 37, 327-330.

[2]ABDELMOLA, A. I., S. M. TABOUN AND S. MERCHAWI, 1998, "PRODUCTIVITY OPTIMIZATION OF CELLULAR MANUFACTURING SYSTEMS," COMPUTERS IND. ENGNG., 35(3-4), 403-406.

[3]AKTURK, M. S. AND G. R. WILSON, 1998, "A HIERARCHICAL MODEL FOR THE CELL LOADING PR -OBLEM OF CELLULAR MANUFACTURING SYSTEMS," INTERNATIONAL JOURNAL OF PRODUCTION RESE -ARCH, 36(7), 2005-2023.

[4]AMIRAHMADI, F. AND F. CHOOBINEH, 1996, "IDENTIFYING THE COMPOSITION OF A CELLULAR M -ANUFACTURING SYSTEM," INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH, 34(9), 2471-24 -88.
[5]ANG, D.S. AND CHARLES E.HEGJI, 1997, "AN ALGORITHM FOR PART FAMILIES IDENTIFICATION IN CELLULAR MANUFACTURING," INTERNATIONAL JOURNAL OF MATERIALS AND PRODUCTION TECHN -OLOGY, 12(4-6), 320-328.
[6]ASKIN, R.G., S.H. CRESSWELL., J.B GOLDBERG AND A.J.VAKHARIA,1991, "A HAMILTONIAN PA -TH APPROACH TO REORDERING THE PART-MACHINE MATRIX FOR CELLULAR MANUFACTURING," INTE -RNATIONAL JOURNAL OF PRODUCTION RESEARCH, 29(6), 1081-1100.
[7]BALAKRISHNAN,J., AND P.D. JOG,1995,"MANUFACTURING CELL FORMATION USING SIMILARITY CO -EFFICIENTS AND A PARALLEL GENETIC TSP ALGORITHM FORMULATION AND COMPARISON", MATHL. COMPUT. MODELING 21(12) 61-73.
[8]BEN-ARIEH, DAVID AND EVANGELOS TRIANTAPHYLLOU , 1992, "QUANTIFYING DATA FOR GROUP TE -CHNOLOGY WITH WEIGHTED FUZZY FEATURES," INTERNATIONAL JOURNAL OF PRODUCTION RESEARC -H, 30(6), 1285-1299.
[9]BEN-ARIEH, D., S. E. LEE AND P. T. CHANG, 1996, "THEORY AND METHODOLOGY: FUZZY PART CODING FOR GROUP TECHNOLOGY," EUROPEAN JOURNAL OF OPERATIONAL RESEARCH, 92, 637-648.
[10]BERARDI, V. L., G. ZHANG AND O. F. OFFODILE, 1999, "A MATHEMATICAL PROGRAMMING APPR -OACH TO EVALUATING ALTERNATIVE MACHINE CLUSTERS IN CELLULAR MANUFACTURING,"INTERNA -TIONAL JOURNAL OF PRODUCTION ECONOMICS, 58, 253-264.
[11]BILLO, R. E., 1998, "A DESIGN METHODOLOGY FOR CONFIGURATION OF MANUFACTURING CELLS," COMPUTERS IND. ENGNG., 34(1), 63-75.
[12]BOCTOR, F.F., 1990, "A LINEAR FORMATION OF THE MACHINE-PART CELL FORMATION PROBLEM", INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH, 29, 343-356.
[13]BUCKLEY, JAMES AND YOICHI HAYASHI,1994,"FUZZY NEURAL NETWORKS: A SURVEY",FUZZY SETS AND SYSTEMS, 66, 1-13 [14]BURKE, L. I. AND S. KAMAL, 1995, "NEURAL NETWORKS AND THE PART FAMILY/MACHINE GROUP FORMATION PROBLEM IN CELLULAR MANUFACTURING: A FRAMEWORK USING FUZZY ART,"JOURNAL OF MANUFACTURING SYSTEMS, 14(3), 148-159.
[15]CAO,Q.AND MARK A. MCKNEW,1998, "PARTIAL TERMINATION RULE OF LAGRANGIAN RELAXATION FO -R MANUFACTURING CELL FORMATION PROBLEMS," COMPUTERS OPS.RES., 25(2), 159-168.
[16]CAUX, C. , R. BRUNIAUX AND H. PIERREVAL, 2000, "CELL FORMATION WITH ALTERNATIVE PROC -ESS PLANS AND MACHINE CAPACITY CONSTRAINTS: A NEW COMBINED APPROACH", INTERNATIONAL JOURNAL OF PRODUCTION ECONOMIC, 64, 279-284.
[17]CARPENTER, G.A. AND S.GROSSBERGT,1987, "A MASSIVELY PARALLEL ARCHITECTURE FOR A SEFL -ORGANIZING NEURAL PATTERN RECOGNITION MACHINE"., 37, 54-115 [18]CHAKRABORTY, K. AND U. ROY, 1993, "CONNECTIONIST MODELS FOR PART-FAMILY CLASSIFICATI -ONS," COMPUTERS IND. ENGNG., 24(2), 189-198.
[19]CHAN, F. T. S., K. L. MAK, L. H. S. LUONG AND X. G. MING, 1998, "MACHINE-COMPONENT GR -OUPING USING GENETIC ALGORITHMS," ROBOTICS AND COMPUTER-INTEGRATED MANUFACTURING,14, 339-346.
[20]CHANDRASEKHARAN M.P. AND R.RAJAGOPALAN, 1987, "ZODIA-AN ALGORITHM FOR CONCURRENT FORM -ATION OF PART-FAMILIES AND MACHINE-CELLS", INTERNATIONAL JOURNAL OF PRODUCTION RESEA -RCH,25(6),835-850.
[21]CHANG P.T. AND E.S. LEE, 2000, "A MULTI-SOLUTION METHOD FOR CELL FORMATION -EXPLORING PRACTICAL ALTERNATIVES IN GROUP TECHNOLOGY MANUFACTURING," COMPUTERS AND MATHEMATICS WITH APPLICATIONS., 40, 1285-1296.
[22]CHEN, S.J. AND C.S. CHENG, 1995, "A NEURAL NETWORK-BASED CELL FORMATION ALGORITHM IN CELLULAR MANUFACTURING" INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH,33(2),293-318.
[23]CHENG, C.H., Y.P. GUPTA., W.H. LEE AND W.F.WONG, 1998,"A TSP-BASED HEURISTIC FOR FORM -ING MACHINE GROUPS AND PART FAMILIES" INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH, 36(5),1325-1337.
[24]CHESTER, MICHAEL, 1993, "NEURAL NETWORKS-A TUTORIAL", PRENTICE-HALL INC.
[25]CHU, C. H., 1997, "AN IMPROVED NEURAL NETWORK FOR MANUFACTURING CELL FORMATION,"DECIS -ION SUPPORT SYSTEMS, 20, 279-295.
[26]CHU, C.H. AND J.C. HAYYA,1991,"A FUZZY CLUSTERING APPROACH TO MANUFACTURING CELL FORM -ATION," INTERNATIONAN JOURNAL OF PRODUCTION RESEARCH,29(7),1475-1487 [27]CHUNG, Y. AND A. KUSIAK, 1994, "GROUPING PARTS WITH A NEURAL NETWORK," JOURNAL OF MAN -UFACTURING SYSTEMS, 13(4), 262-275.
[28]CRAMA, Y. AND M. OOSTEN, 1996, "MODELS FOR MACHINE-PART GROUPING IN CELLULAR MANUFACT -URING," INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH, 34(6), 1693-1713.
[29]DAVE , R. N.,1991 ,"CHARACTERIZATION AND DETECTION OF NOISE IN CLUSTERING", PATTERN R -ECOGNITION LETTERS, 12, 657-664.

[30]DEUTSCH, S.J., S.F. FREEMAN AND M.HELANDER,1998, "MANUFACTURING CELL FORMATION USING AN IMPROVED P-MEDIAN MODEL" COMPUTERS IND. ENGNG., 34(1), 135-146.
[31]ENKE, D., K. RATANAPAN AND C. DAGLI., 1998, "MACHINE-PART FAMILY FORMATION UTILIZING AN ART1 NEURAL NETWORK IMPLEMENTED ON A PARALLEL NEURO-COMPUTER," COMPUTERS IND. ENGN -G., 34(1), 189-205.
[32]FAUSETT, LAURENE, 1994, "FUNDAMENTALS OF NEURAL NETWORKS", PRENTICE HALL INC.
[33]GAREY, M.R. AND D.S. JOHNSON,1979,"COMPUTERS AND INTRACTABILITY:A GUIDE TO THE THEOR -Y OF NP-COMPLETENESS," FREEMAN, NEW YORK.
[34]GINDY, N.N.Z,. T.M. RATCHEV AND K.CASE,1995, "COMPONENT GROUPING FOR GT APPLICATIONS- A FUZZY CLUSTERING APPROACH WITH VALIDITY MEASUE" INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH, 33(9), 2493-2509.
[35]GLOVER, F., 1986, "FUTURE PATHS FOR INTEGER PROGRAMMING AND LINKS TO ARTIFICIAL INTEL -LIGENCE", COMPUTERS AND OPERATION RESEARCH, 13 , 533-549.
[36]GULTOM PARAPAT, 1996, "FUZZY SET THEORY APPLIED TO THE DESIGN OF CELL FORMATION IN CE -LLULAR MANUFACTURING SYSTEMS", PH. D. DISSERTATION, KANSAS STATE UNIVERSITY, USA.
[37]GUNGOR, Z AND FRYZEN ARIKAN,2000, "APPLICATION OF FUZZY DECISION MAKING IN PART-MACHI -NE GROUPING" INTERNATIONAL JOURNAL OF PRODUCTION ECONOMICS, 63, 181-193.
[38]GUPTA, M.M. AND H. DING, 1994,"FOUNDATIONS OF FUZZY NEURAL COMPUTATIONS,"IN F. AMINZA -DEH AND M. JAMSHIDI, EDS.," SOFT COMPUTING:FUZZY LOGIC, NEURAL NETWORKS, AND DISTRI -BUTED ARTIFICIAL INTELLIGENCE,"165-195.
[39]GWIAZDA, A. AND R. KNOSALA, 1997, "GROUP TECHNOLOGY USING NEURAL NETS," JOURNAL OF MA -TERIALS PROCESSING TECHNOLOGY, 64, 181-188.
[40]HANSEN, P.,1986,"THE STEEPEST ASCENT MILDEST DECENT HEURISTIC FOR COMBINATORIAL PROGR -AMMING, CONF. ON NUMERICAL METHODS IN COMBINATORIAL OPTIMIZATION, CAPRI, ITALY.
[41]HARHALAKIS, G., R. NAGI AND J. M. PROTH, 1990, "AN EFFICIENT HEURISTIC IN MANUFACTURI -NG CELL FORMATION FOR GROUP TECHNOLOGY APPLICATIONS," INTERNATIONAL JOURNAL OF PRODU -CTION RESEARCH, 28, 185-198.
[42]HERAGU, S. S. AND S. R. KAKUTURI, 1997, "GROUPING AND PLACEMENT OF MACHINE CELLS," II -E TRANSACTIONS, 29, 561-571.
[43]HO, Y. C. AND C. L. MOODIE, 1996, "SOLVING CELL FORMATION PROBLEMS IN A MANUFACTURING ENVIRONMENT WITH FLEXIBLE PROCESSING AND ROUTING CAPABILITIES," INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH, 34(10), 2901-2923.
[44]HOLLAND, J.H,1975, "ADAPTATION IN NATURAL AND ARTIFICIAL SYSTEMS", UNIVERSITY OF MICH -IGAN PRESS, ANN ARBOR, MI.
[45]HWANG, H. AND J. U. SUN, 1996, "A GENETIC-ALGORITHM-BASED HEURISTIC FOR THE GT CELL F -ORMATION PROBLEM," COMPUTERS IND. ENGNG., 30(4), 941-955.
[46]JOINES, J. A., C. T. CULBRETH AND R. E. KING, 1996, "MANUFACTURING CELL DESIGN: AN IN -TEGER PROGRAMMING MODEL EMPLOYING GENETIC ALGORITHMS," IIE TRANSACTIONS, 28, 69-85.
[47]KAMAL, S. AND L. I. BURKE, 1996, "FACT: A NEW NEURAL NETWORK-BASED CLUSTERING ALGORIT -HM FOR GROUP TECHNOLOGY," INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH,34(4),919-946 [48]KAMRANI, AK, PARSAEI HR, AND LILES DH, 1995, "PLANNING, DESIGN, AND ANALYSIS OF CELLU -LAR MANUFACTURING SYSTEMS", NEW YORK: ELSEVIER.
[49]KAO, Y. AND Y. B. MOON, 1991, "A UNIFIED GROUP TECHNOLOGY IMPLEMENTATION USING THE BA -CKPROPAGATION LEARNING RULE OF NEURAL NETWORKS " COMPUTERS IND.ENGNG,20(4), 425-437.
[50]KAO, Y. AND Y. B. MOON, 1998, "FEATURE-BASED MEMORY ASSOCIATION FOR GROUP TECHNOLOGY, " INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH, 36(6), 1653-1677.
[51]KAPARTHI, S. AND SURESH, N.C,1991, "A NEURAL NETWORK SYSTEM FOR SHAPE-BASED CLASSIFIC -ATION AND CODING OF ROTATIONAL PARTS," INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH, -29(9),1771-1784 [52]KAPARTHI, S. AND SURESH, N.C,1992, "MACHINE-COMPONENT CELL FORMATION IN GROUP TECHNOL -OGY :A NEURAL NETWORK APPROACH ," INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH,30(6) ,1353-1367 [53]KAPARTHI, S. NALLAN C.SURESH AND ROBERT P.CERVENY,1993, "AN IMPROVED NEURAL NETWORK LE -ADER ALGORITHM FOR PART-MACHINE GROUPING IN GROUP TECHNOLOGY ," EROUPEAN JOURNAL OF OPERATIONAL RESEARCH,69,342-356.
[54]KIANG, M.Y., UDAY R. KULKARNI,AND KAR YAN TAM,1995,"SELF-ORGANIZING MAP NETWORK AS IN -TERACTIVE

CLUSTERING TOOL-AN APPLICATION TO GROUP TECHNOLOGY," DECISION SUPPORT SYST -EMS,15,351-374.
[55]KIRKPATRICK, S., GELATT, C.D. JR AND VECCHI, M.P.,1983,"OPTIMIZATION BY SIMULATED ANN -EALING," SCIENCE, 220(4598) ,671-680.
[56]KOSKO, B., 1992, "FUZZY SYSTEMS AS UNIVERSAL APPROXIMATORS", IEEE INTERNATIONAL CONFE -RENCE ON FUZZY SYSTEMS, 1153-1162.
[57]KULKARNI, U. R. AND M. Y. KIANG, 1995, "DYNAMIC GROUPING OF PARTS IN FLEXIBLE MANUFAC -TURING SYSTEMS-A SELF-ORGANIZING NEURAL NETWORKS APPROACH," EUROPEAN JOURNAL OF OPER -ATIONAL RESEARCH, 84, 192-212.
[58]KUMAR C.S AND M.P. CHANDRASEKHARAN, 1990,"GROUPING EFFICICACY :A QUANTITATIVE CRITERI -ON FOR GOODNESS OF BLOCK DIAGONAL FORMS OF BINARY MATRICES IN GROUP TEHNOLOHY",INTER -NATIONAL JOURNAL OF PRODUCTION RESEARCH, 28, 233-243.
[59]KUO, R. J. , S. C. CHI AND P.W. TENG,2001"GENERALIZED PART FAMILY FORMATION THROUGH FU -ZZY SELF-ORGANIZING FEATURE MAP NEURAL NETWORK", COMPUTER &INDUSTRIAL ENGINEERING,40 ,79-100.
[60]LEE, M. K., H. S. LUONG AND K. ABHARY, 1997, "A GENETIC ALGORITHM BASED CELL DESIGN CO -NSIDERING ALTERNATIVE ROUTING," COMPUTER INTEGRATED MANUFACTURING SYSTEMS, 10(2),93- 107.
[61]LEE, C.C, 1990, "FUZZY LOGIC IN CONTROL SYSTEMS: FUZZY LOGIC CONTROL-PARTS I AND II", IEEE TRANSACTIONS ON SYSTEMS, MAN AND CYBERNETICS 20, 404-435.
[62]LEE, S. Y. AND G. W. FISCHER, 1999, "GROUPING PARTS BASED ON GEOMETRICAL SHAPES AND M -ANUFACTURING ATTRIBUTES USING A NEURAL NETWORK,"JOURNAL OF INTELLIGENT MANUFACTURING, 10, 199-209.
[63]LEEM, C. W. AND J. J. CHEN, 1996, "FUZZY-SET-BASED MACHINE-CELL FORMATION IN CELLULAR MANUFACTURING," JOURNAL OF INTELLIGENT MANUFACTURING, 7, 355-364.
[64]LIAO, T.W. AND L.J. CHEN,1993, "AN EVALUATION OF ART1 NEURAL MODELS FOR GT PART FAMIL -Y AND MACHINE CELL FORMING," JOURNAL OF MANUFACTURING SYSTEMS,12(4),282-290 [65]LIAO, T.W.,2001, "CLASSIFICATION AND CODING APPROACHES TO PART FAMILY FORMATION UNDER A FUZZY ENVIRONMENT" FUZZY SETS AND SYSTEMS, 122, 425-441.
[66]MAMDANI, E.H. AND S. ASSILIAN, 1975, "AN EXPERIMENT IN LINGUISTIC SYNTHESIS WITH A FUZ -ZY LOGIC CONTROLLER", INTERNATIONAL JOURNAL OF MAN-MACHINE STUDIES 7, 1-13.
[67]MICHIE,D. AND D.J. SPIEGELHALTER, AND C.C TALOR,1994,"MACHINE ARNING, NEURAL AND STAT -ISTICAL CLASSIFICATION," ELLIS HORWOOD LIMITED.
[68]MITAL, A., S.KROMODIHARDJO AND C.CHANNAVEERAIAH,1988, "INCREASING THE SENSITIVITY OF PARTS CLASSIFICATION SYSTEM" FUZZY SETS AND SYSTEMS, 28, 1-13.
[69]MITAL, A. AND L. SETTINERI, 1997, "INCREASING THE SENSITIVITY OF PARTS CLASSIFICATION SYSTEM" INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH, 35(4), 1077-1094.
[70]MOON, Y. B. AND S. C. CHI, 1992, "GENERALIZED PART FAMILY FORMATION USING NEURAL NETW -ORK TECHNIQUES," JOURNAL OF MANUFACTURING SYSTEMS, 11(3), 149-159.
[71]MOON, C. AND M. GEN, 1999, "A GENETIC ALGORITHM-BASED APPROACH FOR DESIGN OF INDEPEND -ENT MANUFACTURING CELLS," INT. J. PRODUCTION ECONOMICS, 60-61, 421-426.
[72]MOON, Y.B. AND U.ROY , 1992, "LEARNING GROUP-TECHNOLOGY PART FAMILIES FROM SOLID MODE -LS BY PARALLEL DISTRIBUTED PROCESSING," INTERNATIONAL JOURNAL OF ADVANCED MANUFACTUR -ING TECHNOLOGY,7,109-118.
[73]NARAYANASWAMY, P., C. R. BECTOR AND D. RAJAMANI, 1996, "THEORY AND METHODOLOGY: FUZZY LOGIC CONCEPTS APPLIED TO MACHINE-COMPONENT MATRIX FORMATION IN CELLULAR MANUFACTURING ,"EUROPEAN JOURNAL OF OPERATIONAL RESEARCH, 93, 88-97.
[74]NEEDY, K. L., R. E. BILLO AND R. C. WARNER, 1998, "A COST MODEL FOR THE EVALUATION OF ALTERNATIVE CELLULAR MANUFACTURING CONFIGURATIONS," COMPUTERS IND. ENGNG., 34(1), 119 -134.
[75]ONWUBOLU, G.C. AND M. MUTINGI,2001, "A GENETIC ALGORITHM APPROACH TO CELLULAR MANUFAC -TURING SYSTEMS", COMPUTERS AND INDUSTRIAL ENGINEERING,39,125-144.
[76]PHAM, D.T. AND KARABOGA, 2000, "INTELLIGENT OPTIMIZATION TECHNIQUES", SPRINGER-VERLAG INC.
[77]PAI, PING-FENG AND E.S. LEE, 2001, "OPERATIONS RESEARCH IN THE DESIGN OF CELL FORMATI ON IN CELLULAR MANUFACTURING SYSTEMS", GOLDEN JUBILEE VOLUMES,WORLD SCIENTIFIC COMPANY,(TO APPEAR).
[78]PAI, PING-FENG AND E.S. LEE, 2001, "ADAPTIVE FUZZY SYSTEMS APPLICATION IN GROUP TECHN -OLOGY", COMPUTERS AND MATHEMATICS WITH APPLICATIONS, VOLUME 42,ISSUE 10/11,PAGES 1393 -1400.
[79]PAI, PING-FENG AND E.S.LEE,2001"PARTS CLUSTERING BY SELF ORGANIZING MAP NEURAL NETWOR -K IN A FUZZY

ENVIRONMENT",COMPUTERS AND MATHEMATICS WITH APPLICATIONS,VOLUME 42,ISSU -E 1/2, PAGES 179-188.
[80]PHAM,D.T. AND D. KARABOGA,2000,"INTELLIGENT OPTIMIZATION TECHNIQUES",SPRINGER-VERLAG LONDON LIMITED.
[81]PILOT, T. AND R. KNOSALA, 1998, "THE APPLICATION OF NEURAL NETWORKS IN GROUP TECHNOLO -GY," JOURNAL OF MATERIALS PROCESSING TECHNOLOGY, 78, 150-155.
[82]PRASAD, R. AND V.N.RAJAN,1994. "GROUP TECHNOLOGY CELL FORMATION USING THE ART NEURAL NETWORK PARADIGM" INTELLIGENT ENGINEERING SYSTEMS,4,1085-1089 [83]RARDIN R.L., 1998 "OPTIMIZATION IN OPERATIONS RESEARCH", PRENTICE HALL INC.
[84]RAJAMANI, D., N. SINGH AND Y. P. ANEJA, 1996, "DESIGN OF CELLULAR MANUFACTURING SYSTE -MS," INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH, 34(7), 1917-1928.
[85]RAO, HARISH AND P. GU, 1994, "EXPERT SELF-ORGANIZING NEURAL NETWORK FOR THE DESIGN OF CELLULAR MANUFACTURING SYSTEMS", JOURNAL OF MANUFACTURING SYSTEMS, 13(5) 346-358.
[86]SARKER, B. R. AND C. V. BALAN, 1996, "CELL FORMATION WITH OPERATION TIMES OF JOBS FOR EVEN DISTRIBUTION OF WORKLOADS," INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH, 34(5), 1447-1468.
[87]SEIFODDINI. HAMID,1989,"A NOTE ON THE SIMILARITY COEFFICIENT METHOD AND THE PROBLEM OF IMPROPER MACHINE ASSIGNMENT IN GROUP TECHNOLOGY APPLICATIONS,", INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH, 27(7), 1161-1165.
[88]SELIM, H.M., R.G. ASKIN AND A.J. VAKHARIA,1998, "CELL FORMATION IN GROUP TECHNOLOGY: REVIEW, EVALUATION AND DIRECTIONS FOR FEATURE RESEARCH" COMPUTERS IND. ENGNG, 34(1), 3-20.
[89]SEN, S. AND RAJESH N.D.,1999, "APPLICATION OF NOISE CLUSTERING IN GROUP TECHNOLOGY" ANNUAL CONFERENCE OF THE NORTH AMERICAN FUZZY INFORMATION PROCESSING SOCIETY NAFIPS 1999, P 366-370.
[90]SNEAD, CHARLES S.,1989, "GROUP TECHNOLOGY FOUNDATION FOR COMPETITIVE MANUFACTURING", VAN NOSTRAND REIHOLD.
[91]SPILIOPOULOS, K. AND S. SOFIANPOULOU,1998,"AN OPTIMAL TREE SEARCH METHOD FOR THE MAN -UFACTURING SYSTEM CELL FORMATION PROBLEM," EUROPEAN JOURNAL OF OPERATIONAL RESEARCH, 105,537-551.
[92]SPILIOPOULOS, K. AND S. SOFIANOPOULOU,1998, "AN OPTIMAL TREE SEARCH MET" COMPUTERS IND. ENGNG, 34(1), 3-20.
[93]SU, C. T. AND C. M. HSU, 1996, "A TWO PHASED GENETIC ALGORITHM FOR THE CELL FORMATION PROBLEM," INTERNATIONAL JOURNAL OF INDUSTRIAL ENGINEERING, 3(2), 114-125.
[94]SU, CHWNE-TZENG, 1995, "A FUZZY APPROACH FOR PART FAMILY FORMATION, "INTERMATIONAL IE -EE/IAS CONFERENCE, 289-292.
[95]SUN, D L.LIN AND R.BATTA,1995, "CELL FORMATION USING TABU SEARCH," COMPUTERS IND. ENG -NG., 28(3), 485-494.
[96]SUNDARAM, R. M. AND K. DOSHI, 1993, "CELLULAR MANUFACTURING SYSTEM DESIGN WITH ALTERN -ATIVE ROUTING CONSIDERATION," COMPUTERS IND. ENGNG., 25(1-4), 477-480.
[97]SURESH, N. C. AND S. KAPARTHI, 1994, "PERFORMANCE OF FUZZY ART NEURAL NETWORK FOR GRO -UP TECHNOLOGY CELL FORMATION," INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH, 32(7), 1693-1713.
[98]SURESH, N. C. J.SLOMP AND S. KAPARTHI, 1995, "THE CAPACITATED CELL FORMATION PROBLEM: A NEW HIERARCHICAL METHODOLOGY" INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH, 33(6), 1761-1784.
[99]SURESH, N. C., J. SLOMP AND S. KAPARTHI, 1999, "SEQUENCE-DEPENDENT CLUSTERING OF PART -S AND MACHINES: A FUZZY ART NEURAL NETWORK APPROACH," INTERNATIONAL JOURNAL OF PRODU -CTION RESEARCH, 37(12), 2793-2816.
[100]SZWARC.D,D. RAJAMANI AND C.R. BECTOR,1997,"CELL FORMATION CONSIDERING DEMAND AND MACH -INE CAPACITY, "INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH,13,134-147.
[101]TAKAGI, T. AND M. SUGENO, 1985, "FUZZY IDENTIFICATION OF SYSTEMS AND ITS APPLICATIONS TO MODELING AND CONTROLLING" IEEE TRANS. ON SYSTEMS, MAN, AND CYBERN, SMC-15(1), 116 -132.
[102]TABOUN S.M. N.S. MERCHAWI AND T. ULGER,1998, "AN TWO-STAGE MODEL FOR COST EFFECTIVE PART FAMILY AND MACHINE CELL FORMATION," COMPUTERS IND.ENGNG,34(4),759-776.
[103]TSAI, C. C., C. H. CHU AND A. T. BARTA, 1994,"FUZZY LINEAR PROGRAMMING APPROACH TO MA -NUFACTURING CELL FORMATION," IEEE WORLD CONGRESS ON COMPUTATIONAL INTELLIGENCE,2,1406 -1411.
[104]TSAI, C. C., C. H. CHU AND A. T. BARTA, 1997, "MODELLING AND ANALYSIS OF MANUFACTURING CELL FORMATION PROBLEM WITH FUZZY MIXED-INTEGER PROGRAMMING,"IIE TRANSACTIONS, 29(7), 533-547.
[105]VENUGOPAL, V. AND T. T. NARENDRAN, 1992, "A GENETIC ALGORITHM APPROACH TO THE MACHINE -COMPONENT GROUPING PROBLEM WITH MULTIPLE OBJECTIVES," COMPUTERS IND. ENGNG., 22(4), 469-480.

[106]VENUGOPAL, V. AND T. T. NARENDRAN, 1992, "A NEURAL NETWORK APPROACH FOR DESIGNING CELL -ULAR MANUFACTURING SYSTEMS," ADVANCES IN MODELLING AND ANALYSIS, 32(2), 13-26.
[107]WANG, LI-XIN, 1994, "ADAPTIVE FUZZY SYSTEMS AND CONTROL", PRENTICE HALL INC. NEW JERS -EY.
[108]WANG, LI-XIN AND J.M. MENDEL, 1992, "FUZZY SYSTEMS ARE UNIVERSAL APPROXIAMTORS",IEEE INTERNATIONAL CONFERENCE ON FUZZY SYSTEMS, 1163-1170.
[109]WEN H.J., C.H.SMITH AND E.D. MINOR,1996, "FORMATION AND DYNAMIC ROUTING OF PART FAMIL -IES AMONG FIXABLE MANUFACTURING CELLS" INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH, 34(8), 2229-2245.
[110]WU, M.C. AND S.R. JEN,1996,"A NEURAL NETWORK APPROACH TO THE CLASSIFICATION OF 3D PRIS -MATIC PARTS," INTERATIONAL JOURNAL OF ADVANCED MANUFACTURING TECHNOLOGY,(11),325-335 [111]XU.H. AND H.P. WANG,1989,"PART FAMILY FORMATION FOR GT APPLICATIONS BASED ON FUZZY MA -THEMATICS, "INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH,27(9),1637-1651.
[112]YASUDA.K, AND Y.YIN, 2001, "A DISSIMILARITY MEASURE FOR SOLVING THE CELL FORMATION PR -OBLEM IN CELLULAR MANUFACTURING,"COMPUTERS & INDUSTRIAL ENGINEERING,(39),1-17.
[113]ZADEH, L.A., 1965, "FUZZY SETS", INFORMATION AND CONTROL, 338-353.
[114]ZHANG, C. AND H. WANG, 1992, "CONCURRENT FORMATION OF PART FAMILIES AND MACHINE CELLS BASED ON THE FUZZY SET THEORY," JOURNAL OF MANUFACTURING SYSTEMS, 11(1), 61-67.
[115]ZHOU, M. AND R. G. ASKIN, 1998, "FORMATION OF GENERAL GT CELLS: AN OPERATION-BASED AP -PROACH," COMPUTERS IND. ENGNG., 34(1), 147-157.
[116]ZOLFAGHARI,S. AND M. LIANG,1998,"MACHINE CELL/PART FAMILY FORMATION CONSIDERING PROCE -SSING TIMES AND MACHINE CAPACITIES: A SIMULATED ANNEALING APPROACH " COMPUTERS IND. ENGNG., 34(4), 813-818