

Biological pattern recognition by neural networks

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ABSTRACT: Neural network analysis was proposed and evaluated as a method for image analysis of plankton data derived from automatic counting techniques. It was shown that a neural network with 2 layers of weights was capable of learning a large data set by the backward-error propagation method. Significant results were achieved in separating novel images of 2 co-occurring species of *Ceratium* spp. from the western North Atlantic Ocean.

INTRODUCTION

There is a growing concern amongst the marine scientific community about the diminishing numbers of competent plankton taxonomists remaining in, and being recruited to, research. This has led to a number of initiatives attempting to overcome this problem using automated pattern recognition techniques (Jeffries et al. 1984, Rolke & Lenz 1984, Steidinger et al. 1990). Certainly it is a generally held belief that the majority of plankton samples will eventually be sorted, counted and taxonomically analysed using automatic techniques. No definitive system has yet been built but it is highly likely that pattern recognition and image processing will be the method to achieve the processing of the data. There is also a growing requirement for discrimination and identification of video images collected from cameras mounted on remote vehicles and towed systems. Recognition of biological patterns by neural networks is a new concept and one which we suggest could play a role in achieving these ends.

The majority of previous attempts to use automated pattern recognition for taxonomic identification have utilised explicitly statistical techniques, whereby morphological measurements are made on sample data (either by hand or by some automatic image analysis technique), and the measurements submitted to discriminant analysis (Yarranton 1967, Jeffries et al. 1980, 1984). Typically such techniques involve making a wide range of measurements, and using the statistical analysis to determine which measurements or combi-

nation of measurements allows the best discrimination to be made. Obtaining images clean enough to enable accurate measurement is itself quite problematic. A neural network approach was considered suitable for this type of problem for a number of reasons: (1) neural networks (strictly, artificial neural networks) are able to be taught, i.e. exposed to data and 'told' what the correct response (e.g. category) is for that stimulus, and do not need to be given a rule-base to determine behaviour; (2) they are able to form arbitrary input-output mappings, and so can be used in a wide variety of domains; (3) they have been shown to be largely resistant to noisy or imperfect inputs; (4) their massive operational parallelism means that hardware versions of networks can be made that perform very complex mapping tasks at great speed.

MATERIALS AND METHODS

Samples. To assess the possibilities of artificial neural networks' discriminating images of planktonic species, specimens of the genera *Ceratium* were used. *Ceratium* spp. are generally compressed in one plane and are ideal organisms for drawing or video imaging. They are also morphologically variable and specimens are at times difficult to separate, when there can be up to 20 different and distinct species of the genera occurring in one plankton sample. The 2 species selected were *C. arcticum* (Ehrenberg) Cleve, and *C. longipes* (Bailey) Gran., which have sympatric geographical distributions in the western Atlantic Ocean.

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Pattern Recognition In Biological Tech:

Scientific and Technical Aerospace Reports, 1972 *Artificial Intelligence Technologies for Computational Biology*
Ranjeet Kumar Rout, Saiyed Umer, Sabha Sheikh, Amrit Lal Sangal, 2022-11-10 This text emphasizes the importance of artificial intelligence techniques in the field of biological computation. It also discusses fundamental principles that can be applied beyond bio-inspired computing. It comprehensively covers important topics including data integration, data mining, machine learning, genetic algorithms, evolutionary computation, evolved neural networks, nature-inspired algorithms, and protein structure alignment. The text covers the application of evolutionary computations for fractal visualization of sequence data, artificial intelligence, and automatic image interpretation in modern biological systems. The text is primarily written for graduate students and academic researchers in areas of electrical engineering, electronics engineering, computer engineering, and computational biology. This book covers algorithms in the fields of artificial intelligence and machine learning useful in biological data analysis. Discusses comprehensively artificial intelligence and automatic image interpretation in modern biological systems. Presents the application of evolutionary computations for fractal visualization of sequence data. Explores the use of genetic algorithms for pair-wise and multiple sequence alignments. Examines the roles of efficient computational techniques in biology. **WADC Technical Report** United States. Wright Air Development Division, 1960 **Aerospace Medicine and Biology**, 1972 **Geophysical Exploration Technology** Ming Li, 2014-02-06 Authored by one of the world's hydrocarbon exploration experts. *Geophysical Exploration Technology Applications in Lithological and Stratigraphic Reservoirs* presents the latest technological advancements and cutting-edge techniques in reservoir theory, research, and exploration. Stratigraphic and lithological reservoirs play a critical role in increasing the production from oil reserves and new hydrocarbon sources. Recent resource evaluations indicate that onshore stratigraphic and subtle reservoirs account for as much as 40% of the total remaining hydrocarbon sources globally. As a result, these reservoirs will be the most practical potential and prevalent fields for long-lasting onshore exploration. Intended as an aid in developing an understanding of the techniques of reservoir exploration, this book presents the latest and most practical methods and technology in oil and gas exploration. It can be used as a training book for lithological stratigraphic exploration and a reference for scientific and technological personnel in the oil and gas industry. Authored by one of the world's foremost experts in stratigraphic and lithological reservoir exploration who has more than 30 years of experience in research and instruction. Features more than 200 figures, illustrations, and working examples to aid the reader in retaining key concepts. Presents the latest technological developments in reservoir exploration techniques. Integrates theory and application, arming readers with a rigorous yet practical approach to hydrocarbon exploration in stratigraphic and lithological reservoirs. The Biology and Technology of Intelligent Autonomous Agents Luc Steels, 2012-12-06 The NATO-sponsored Advanced Study Institute The Biology and Technology of Intelligent Autonomous Agents was an extraordinary event. For two weeks it brought together the leading

proponents of the new behavior oriented approach to Artificial Intelligence in Castel Ivano near Trento The goal of the meeting was to establish a solid scientific and technological foundation for the field of intelligent autonomous agents with a bias towards the new methodologies and techniques that have recently been developed in Artificial Intelligence under the strong influence of biology Major themes of the conference were bottom up AI research artificial life neural networks and techniques of emergent functionality The meeting was such an extraordinary event because it not only featured very high quality lectures on autonomous agents and the various fields feeding it but also robot laboratories which were set up by the MIT AI laboratory with a lab led by Rodney Brooks and the VUB AI laboratory with labs led by Tim Smithers and Luc Steels This way the participants could also gain practical experience and discuss in concreto what the difficulties and achievements were of different approaches In fact the meeting has been such a success that a follow up meeting is planned for September 1995 in Monte Verita Switzerland This meeting is organised by Rolf Pfeifer University of Zurich

Publications of the National Institute of Standards and Technology ... Catalog National Institute of Standards and Technology (U.S.),1971

Technical Abstract Bulletin ,1964 XIII Mediterranean Conference on Medical and Biological Engineering and Computing 2013 Laura M. Roa Romero,2013-10-01 The general theme of MEDICON 2013 is Research and Development of Technology for Sustainable Healthcare This decade is being characterized by the appearance and use of emergent technologies under development This situation has produced a tremendous impact on Medicine and Biology from which it is expected an unparalleled evolution in these disciplines towards novel concept and practices The consequence will be a significant improvement in health care and well fare i e the shift from a reactive medicine to a preventive medicine This shift implies that the citizen will play an important role in the healthcare delivery process what requires a comprehensive and personalized assistance In this context society will meet emerging media incorporated to all objects capable of providing a seamless adaptive anticipatory unobtrusive and pervasive assistance The challenge will be to remove current barriers related to the lack of knowledge required to produce new opportunities for all the society while new paradigms are created for this inclusive society to be socially and economically sustainable and respectful with the environment In this way these proceedings focus on the convergence of biomedical engineering topics ranging from formalized theory through experimental science and technological development to practical clinical applications Catalog of National Bureau of Standards Publications, 1966-1976: Key word index United States. National Bureau of Standards. Technical Information and Publications Division,1978 **Catalog of National Bureau of Standards Publications, 1966-1976** United States.

National Bureau of Standards. Technical Information and Publications Division,1978 *Neural Modeling and Neural Networks* F. Ventriglia,2013-10-22 Research in neural modeling and neural networks has escalated dramatically in the last decade acquiring along the way terms and concepts such as learning memory perception recognition which are the basis of neuropsychology Nevertheless for many neural modeling remains controversial in its purported ability to describe brain

activity The difficulties in modeling are various but arise principally in identifying those elements that are fundamental for the expression and description of superior neural activity This is complicated by our incomplete knowledge of neural structures and functions at the cellular and population levels The first step towards enhanced appreciation of the value of neural modeling and neural networks is to be aware of what has been achieved in this multidisciplinary field of research This book sets out to create such awareness Leading experts develop in twelve chapters the key topics of neural structures and functions dynamics of single neurons oscillations in groups of neurons randomness and chaos in neural activity statistical dynamics of neural networks learning memory and pattern recognition

Semantic Mining Technologies for Multimedia Databases Tao, Dacheng,Xu, Dong,Li, Xuelong,2009-04-30 Provides an introduction to recent techniques in multimedia semantic mining necessary to researchers new to the field

1st World Congress on Electroporation and Pulsed Electric Fields in Biology, Medicine and Food & Environmental Technologies Tomaz Jarm,Peter Kramar,2015-08-31 This volume presents the proceedings of the 1st World Congress on Electroporation and Pulsed Electric Fields in Biology Medicine and Food Environmental Technologies WC2015 The congress took place in Portoro Slovenia during the week of September 6th to 10th 2015 The scientific part of the Congress covered different aspects of electroporation and related technologies and included the following main topics Application of pulsed electric fields technology in food challenges and opportunities Electrical impedance measurement for assessment of electroporation yield Electrochemistry and electroporation Electroporation meets electrostimulation Electrotechnologies for food and biomass treatment Food and biotechnology applications In vitro electroporation basic mechanisms Interfacial behaviour of lipid assemblies membranes and cells in electric fields Irreversible electroporation in clinical use Medical applications electrochemotherapy Medical applications gene therapy Non electric field based physical methods inducing cell poration and enhanced molecule transfer Non thermal plasmas for food safety environmental applications and medical treatments PEF for the food industry fundamentals and applications PEF proce ss integration complex process chains and process combinations in the food industry Predictable animal models Pulsed electric fields and electroporation technologies in bioeconomy Veterinary medical applications

Artificial Intelligence with Uncertainty Deyi Li,Yi Du,2017-05-18 This book develops a framework that shows how uncertainty in Artificial Intelligence AI expands and generalizes traditional AI It explores the uncertainties of knowledge and intelligence The authors focus on the importance of natural language the carrier of knowledge and intelligence and introduce efficient physical methods for data mining amd control In this new edition we have more in depth description of the models and methods of which the mathematical properties are proved strictly which make these theories and methods more complete The authors also highlight their latest research results

Subject Index of Current Research Grants and Contracts Administered by the National Institute of General Medical Sciences National Institute of General Medical Sciences (U.S.),1975

Cross-Disciplinary Applications of Artificial Intelligence and Pattern Recognition:

Advancing Technologies Mago, Vijay Kumar, Bhatia, Nitin, 2011-12-31 The need for intelligent machines in areas such as medical diagnostics biometric security systems and image processing motivates researchers to develop and explore new techniques algorithms and applications in this evolving field Cross Disciplinary Applications of Artificial Intelligence and Pattern Recognition Advancing Technologies provides a common platform for researchers to present theoretical and applied research findings for enhancing and developing intelligent systems Through its discussions of advances in and applications of pattern recognition technologies and artificial intelligence this reference highlights core concepts in biometric imagery feature recognition and other related fields along with their applicability

Decision Forests for Computer Vision and Medical Image Analysis Antonio Criminisi, J Shotton, 2013-01-30 This practical and easy to follow text explores the theoretical underpinnings of decision forests organizing the vast existing literature on the field within a new general purpose forest model Topics and features with a foreword by Prof Y Amit and Prof D Geman recounting their participation in the development of decision forests introduces a flexible decision forest model capable of addressing a large and diverse set of image and video analysis tasks investigates both the theoretical foundations and the practical implementation of decision forests discusses the use of decision forests for such tasks as classification regression density estimation manifold learning active learning and semi supervised classification includes exercises and experiments throughout the text with solutions slides demo videos and other supplementary material provided at an associated website provides a free user friendly software library enabling the reader to experiment with forests in a hands on manner

Artificial Neural Networks - ICANN 2010 Konstantinos Diamantaras, Wlodek Duch, Lazaros S. Iliadis, 2010-09-03 This three volume set LNCS 6352 LNCS 6353 and LNCS 6354 constitutes the refereed proceedings of the 20th International Conference on Artificial Neural Networks ICANN 2010 held in Thessaloniki Greece in September 2010 The 102 revised full papers 68 short papers and 29 posters presented were carefully reviewed and selected from 241 submissions The third volume is divided in topical sections on classification pattern recognition learning algorithms and systems computational intelligence IEM3 workshop CVA workshop and SOINN workshop

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