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Wirtschaft

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Computernetze

In dieser Ausgabe:

In der nächsten Ausgabe:

- Bericht von Prof. Eilenberger über die Dynamics Days 1994
- Vorschau auf das Symposium „Chaos und Strukturbildung '94"
- Chaosforschung, eine wissenschaftliche Revolution?

Editorial

Liebe Leser,

Hauptthema dieser Ausgabe sind Aspekte nichtlinearer Modelle in der Soziologie und in der Volkswirtschaft. Unter anderem haben wir den Artikel von Alexia Prskawetz hier abgedruckt. Dieser Artikel konnte nicht in den Proceedings zur letzten Jahrestagung erscheinen, weil die TU in ihren FAKTUM-Büchern keine englischsprachigen Artikel möchte.

Desweiteren bringen wir einen Überblick über diejenigen Vorträge auf dem Welt-Soziologen-Kongreß in Bielefeld, die am meisten mit nichtlinearer Modellierung zu tun haben. Wenn man die Referenzen miteinbezieht, hat man in dieser ChaoNen-Ausgabe schon einen brauchbaren Überblick über die nichtlinearen Aktivitäten der Soziologen und die soziologischen Aktivitäten der nichtlinearen Forscher.

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Viele Grüße,

Werner Eberl

Gewißheit, Meßfehler, Stochastizität und nichtlineare Dynamik in sozialen Prozessen

Klaus G. Troitzsch

Vortrag auf dem XIII. Weltkongreß der Soziologie, Bielefeld, 18.–24. Juli 1994, RC35 (Committee on Conceptual and Terminological Analysis), Session 03 "Certainty"

1. Sozialwissenschaftliche Begriffe

In den Sozialwissenschaften haben wir die Situation, daß die meisten Begriffe vage und mehrdeutig sind [Sar83], daß ihre Messung zweifelhafte Operationalisierung auf disparaten Skalen erfordert und daß diese Messungen durch Stichprobenfehler (die mathematisch erfolgreich behandelt werden können) oder durch systematische Fehler (für die das nicht gilt) verzerrt sind.

Einige Beispiele mögen diese Probleme ein wenig veranschaulichen:

- Die meisten Leute glauben, sie wissen, was „links“ und „rechts“ in der Politik bedeuten. Es gibt jedoch keine einheitlich benutzte Skala (sei sie nun quantitativ, ordinal oder auch nur dichotom), auf der jede politische Partei, alle, die bei einer Wahl kandidieren, oder jeder Wähler positioniert werden könnte — obwohl genau dies in vielen Büchern und Aufsätzen über Wählerverhalten getan wird, vielleicht wegen der hohen Korrelationen, die man gewöhnlich zwischen verschiedenen „links“-“rechts“-Skalen finden kann.
- Selbst einfache Dichotomien können sich als vage herausstellen: man versuche, einem Besucher aus einer fernen Galaxie den sozialen Unterschied zwischen den beiden Geschlechtern zu erklären (wenn es denn einen gibt).
- Die meisten Messungen in den Sozialwissenschaften geschehen dadurch, daß den Befragten Skalen vorgelegt werden, daß Personen gefragt werden, ob oder in welchem Maße sie einer bestimmten Aussage zustimmen; meist ist die Zahl solcher Skalen oder Aussagen groß, um damit das Problem der Multidimensionalität von Begriffen zu lösen.
- Die meisten Messungen in den Sozialwissenschaften werden an Stichproben vorgenommen, die aus den jeweiligen Grundgesamtheiten entnommen werden, eine Praxis, die eigentlich nur Aussagen wie „mit einer Wahrscheinlichkeit von p ist die Größe einer Subpopulation in der Grundgesamtheit größer (oder kleiner) als q“ — wir dürfen nicht sagen: „sie ist q“.
- Die meisten Stichprobenverfahren in den Sozialwissenschaften ergeben keine mathematischen Stichproben, sondern sind verzerrt, weil manche Teilpopulationen eine geringere Neigung haben, sich an Umfragen zu beteiligen. Selbst Totalerhebungen können dieser Verzerrung unterliegen.
- Interviewfragen werden oftmals suggestiv gestellt, so daß Leute antworten, obwohl sie noch nicht einmal über das in der Frage angesprochene Problem nachgedacht haben.

Wenn auch Techniken entwickelt worden sind, um verzerrte Stichproben zu korrigieren und schlecht formulierte Fragen zu vermeiden, bleiben eine Menge Unzuträglichkeiten übrig.

2. Modelle und Theorien

Modellieren bedeutet die Konstruktion eines Abbildes eines bestimmten Ausschnitts aus der Realität. Modellieren beginnt mit der Definition des zu modellierenden Weltausschnitts, d.h. mit der Entscheidung, welche Elemente der Realität im Modell wiedergegeben werden sollen und welche nicht.

Eine weit verbreitete Methode beginnt mit der Definition von Typen von Modellobjekten, die bestimmte natürliche Gattungen von Dingen repräsentieren, die in der Wirklichkeit identifiziert werden können (aber in dieser Weltsicht des „wissenschaftlichen Realismus" [Bun77] unterstellen wir immer schon, daß es solche „natürlichen Gattungen" in der Wirklichkeit auch „gibt", obwohl wir ganz gut wissen, daß die meisten Dinge in der Wirklichkeit und *a fortiori* in der sozialen Welt Individuen und daher verschieden sind — vergleiche „daß hier eine Hand ist" [Wit72, § 25] und „Dies ist meine Hand" [Wit72, § 448] gegenüber „Was hier wie eine Hand ausschaut, ist nicht eine ausgezeichnete Imitation, sondern wirklich eine Hand." [Wit72, § 461]).

Der zweite Schritt dieser verbreiteten Modellierungstechnik ist die Definition von Attributen der Modellobjekten, welche die Eigenschaften repräsentieren (die direkt gemessen werden können oder auch nicht). So unterstellen wir, daß alle Dinge, die zu derselben „natürlichen Gattung" gehören, auch dieselben Eigenschaften (wie Farbe, Struktur der Blätter oder Gestalt der Zweige — bei Bäumen —, Geschlecht oder „links"-„rechts"-Position — bei Menschen —) und daß diese von Natur aus vagen Eigenschaften durch eindimensionale (nominale, dichotome, ordinale oder sogar quantitative) Attribute so repäsentiert werden können, daß

- eine Ulme durch ein Objekt vom Typ `Baum` vertreten wird, dessen Attribut `Astform` den Wert `Äste mit einzelnen, leicht schiefen kurzgestielten Blättern` hat, während eine Esche von einem `Baum`-Objekt dargestellt wird, dessen `Astform`-Attribut den Wert `Äste mit unpaarig gefiederten Blättern` hat [Wit72, § 649] —
- in der gleichen (unvollkommenen) Weise ein „Kandidat des linken Flügels" durch ein Objekt vom Typ `Kandidat` vertreten wird, dessen Attribut `Einstellung zu Steuererhöhungen für Besserverdienende` den Wert `dafür` hat, während ein „Kandidat des rechten Flügels" durch ein `Kandidat`-Objekt dargestellt wird, das bei diesem Attribut den Wert `dagegen` annimmt [Kue86, p. 84], oder
- ein Postmaterialist [Ing77] durch ein Objekt vom Typ `Bürger` dargestellt wird, dessen Attribut `Soll man unsere Städte und Landschaften schöner machen?` den Wert `dafür` annimmt und so weiter ...

Während wir in Wittgensteins Beispiel ganz sicher sein können, daß alle individuellen Ulmen und Eschen die gleichen Unterscheide aufweisen, nicht nur soweit es ihre Zweige angeht, weil sie zwei verschiedene (und nicht einmal eng verwandte) Gattungen von Bäumen bilden, können wir in den Beispielen, die den Sozialwissenschaften entnommen sind, nicht sicher sein, daß wir in der Lage sein werden, verschiedene Gruppen zu entdecken und alle Fälle korrekt zu klassifizieren — nicht so sehr, weil wir nicht genug über die individuellen Eigenschaften wüßten, sondern weil sie über ihre jeweiligen Skalen mehr oder weniger normalverteilt sein (vgl. z.B. [Dow68, Sar76]) — und die meisten Sozialwissenschaftler, die die verbreiteten statistischen Methoden anwenden, bemühen sich noch nicht einmal darum, nicht-normale und multimodale Verteilungen zu identifizieren.

Der dritte Schritt ist die Definition von Abhängigkeiten zwischen Objekten (desselben Typs oder verschiedener Typen) und ihrer Attribute. Diese Abhängigkeiten im Modell spiegeln die Abhängigkeiten wider, die in der Realität beobachtet werden können. In diesem Schritt formulieren wir erst bloß, daß es Abhängigkeiten „gibt" (wie in „daß das Wasser im Kessel auf der Gasflamme nicht gefrieren, sondern kochen wird" [Wit72, § 613]), und sparen uns die exakte mathematische oder programmiersprachliche Formulierung dieser Abhängigkeiten (oder Gesetze) für den vierten und letzten Schritt zunehmender Abstraktion auf, zu dem wir durch den Glauben geführt werden, daß die Dinge (einschließlich natürlich lebender Dinge wie Männer und Frauen) sich in der Realität ordentlich und verlässlich (wenigstens mit einem bestimmten Maß an Verläßlichkeit), d.h. gesetzmäßig, benehmen (wie in „daß Wasser bei ca. $100^o C$ koche" [Wit72, §§ 293, 599, 604]).

2.1 Axiomatisierung

Dieses Modellierungsverfahren (die in der oben benutzten Formulierung der Informatik entlehnt ist) ist sehr ähnlich dem Axiomatisierungsverfahren, das der moderne Strukturalismus [Sne79, BMS87] eingeführt hat, in dem eine Theorie als eine mathematische Struktur gebildet wird, die aus zwei Elementen, einem *Theoriekern* und einer Menge *intendierter Anwendungen* besteht. Dabei ist die letztere eine Menge von ähnlichen Realitätsausschnitten, die mit der Hilfe der Theorie beschrieben und analysiert werden sollen, während *Theoriekern* ein Tripel aus drei Mengen von „Modellen einer Theorie“ ist:

- potentiellen
  Modellen: mathematischen Strukturen, die gerade alle Begriffe enthalten, die in der betrachteten Theorie benutzt werden dürfen,
- partiellen Modellen: mathematischen Strukturen, die nur jene Begriffe enthalten, die schon ohne Anwendung der betrachtenen Theorie gemessen werden können,
- Modellen: mathematischen Strukturen, die nicht nur alle Begriffe enthalten, die in der betrachteten Theorie benutzt werden dürfen, sondern zusätzlich noch die Axiome oder Invarianten, die die Theorie postuliert.

Die Schritte eins bis drei des oben beschriebenen Modellierungsverfahrens führen zu potentiellen Modellen, wenn diese Attribute enthalten, die nicht gemessen werden können, und zu partiellen Modellen, wenn diese ohne jene Attribute auskommen. Der vierte Schritt, in dem erst das eigentliche Simulationsmodell geschaffen wird, daß auf einem Computer ablauffähig ist, weil alle Abhängigkeiten zwischen Objekten und Attributen spezifiziert sind, liefert ein (vollständiges) Modell.

In beiden Fällen — strukturalistische Theorienrekonstruktion wie Computersimulation — wird eine formale (z.B. mathematische) Struktur als Repräsentant einer Klasse von Realitätsausschnitten verstanden und benutzt, um zu verstehen, zu erklären oder vorherzusagen, was in einem oder mehreren Realitätsausschnitten dieser Klasse geschehen ist, geschieht oder geschehen wird.

2.2 Deterministische *vs.* stochastische Gesetze

Während die meisten Gesetze in der (klassischen) Physik deterministisch sind, scheinen die „Gesetze“ der Sozialwissenschaften bloß stochastische Gesetze zu sein. Bei gegebenen Bedingungen, wie reines Wasser im Kessel und Standardluftdruck, wird sich der Phasenübergang von (flüssigem) Wasser zu Wasserdampf immer bei genau (nicht ca.) 100^oC vollziehen, und jede andere Umgebungsbedingung wird irrelevant sein.

So „finden sich ja auch die Lehrsätze der Physik in Lehrbüchern für jedermann“ [Wit72, § 555] und „ich habe keinen Grund, ihnen nicht zu trauen“ [Wit72, § 600].

Ein vergleichbarer Fall in der Soziologie, über den kürzlich [GH93] berichtet wurde, ist der folgende.

Man nehme an, eine gleichbleibende Gruppe von Leuten trifft sich regelmäßig zum Abendessen, alle bestellen ihre Speisen nach Belieben und bezahlen die Gesamtrechnung zu gleichen Teilen. In dieser Situation scheint es rational, das teuerste Gericht zu bestellen und nur den Durchschnittspreis zu bezahlen — mindestens solange es noch Leute in der Gruppe gibt, die sich mit einem billigen Mahl zufriedengeben, obwohl auch sie den Durchschnittspreis zu zahlen haben. In einer völlig rationalen und deterministischen Welt würde natürlich jeder das teuerste Mahl bestellen. Nehmen wir weiter an, daß manchmal manche Leute die Preise vor dem Bestellen noch nicht gelesen haben und also im Irrtum über die rationale Auswahl der Speisen verbleiben. Dann — unter bestimmten Voraussetzungen bezüglich der Preisunterschiede, die Anzahl der Abendessen, die die Gruppe noch gemeinsam einnehmen wird, und bezüglich der Wahrscheinlichkeit von Irrtümern — führt uns ein formales spieltheoretisches Modell zu der Vorhersage, daß nach einiger Zeit viele oder sogar alle Mitglieder der Gruppe das billigere Gericht wählen und für längere Zeit oder sogar für immer auch so weitermachen *könnten* — eine Vorhersage vom Typ „Gruppen verhalten sich wahrscheinlich kooperativ, wenn sie weniger als n_0 umfassen“, wobei n_0 von dem Preisunterschied und der Irrtumswahrscheinlichkeit abhängt und „wahrscheinlich“ bedeutet: „mit Wahrscheinlichkeit p nach t Abendessen“.

Lehrsätze der Soziologie (oder hier eher der Spieltheorie) wie diesen findet man nicht in Lehrbüchern für jedermann (sondern nur in spezialisierten Zeitschriften), und wir haben alle Gründe, ihnen nicht zu trauen, denn sie haben den gleichen Grad an Sicherheit wie Aussagen über den Ausgang einer Lotterie (wenn auch natürlich für den Buchmacher solche Aussagen schon ganz nützlich sind).

Die moderne Physik scheint uns zu lehren, daß Phasenübergänge wie der von flüssigem Wasser zu Wasserdampf auch bloß stochastisch sind, aber im Alltag interessieren uns Wassermengen, die deutlich weniger als 10^{23} Moleküle enthalten, ziemlich wenig, während wir uns auf der anderen Seite für das Verhalten von Gruppen mit mehr als ein paar hundert (oder ein paar Milliarden) Leuten nicht interessieren. Damit sind wir, statistisch gesprochen, im Alltag sehr nahe an den Erwartungswerten, soweit es um physikalische Phänomene geht, während wir — mit gehöriger Wahrscheinlichkeit — sehr weit von den Erwartungswerten entfernt sein können, wenn es um soziale Phänomene geht.

2.3 Lineare *vs.* nichtlineare Gesetze

Selbst deterministische Gesetze sind nur verläßlich, wenn sie linear sind oder — im Falle der Nichtlinearität — wenn nur wenige Attribute miteinander in Beziehung stehen. Die klassische Physik (und die zugehörige Mathematik) lehrt uns, daß die ferne Zukunft von drei sich umeinander bewegenden Körpern nicht vorhergesagt werden kann, weil es uns nie gelingen wird, ihre Anfangspositionen und -geschwindigkeiten vorherzusagen.

In unserem Fall der Soziologie werden wir wahrscheinlich selten nur drei Objekte in unseren Modellen haben, und noch weniger wahrscheinlich werden wir Anfangsbedingungen (auf welchen Skalen eigentlich, wenn Meß- und Stichprobenfehler nicht vermieden werden können?) genau genug messen können, und es ist auch nicht vernünftig anzunehmen, daß Menschen sich stets nach linearen Gesetzen benehmen — sogar in einem so relativ einfachen Fall wie der Demographie, die nur eine ganz beschränkte Anzahl von Interaktionarten zwischen Menschen betrachtet und bei der die Populationsgrößen hinreichend groß sind, um eine ganz gute Vorhersage zu ermöglichen, ist es nicht vernünftig anzunehmen, daß die Anzahl sowohl der Geburten als auch der Todesfälle linear mit der Größe der Bevölkerung variiert.

3. Schlußfolgerungen

Sozialwissenschaftliche Theoriebildung muß sich mit nichtlinearen Prozessen in komplexen Systemen befassen, die oft nur stochastisch modelliert werden können — sei es weil wir nicht genug über den deterministischen Hintergrund menschlichen Verhaltens wissen oder weil wir nicht daran glauben, menschliches Verhalten sei deterministisch —, so daß wir bestenfalls Übergangswahrscheinlichkeiten zwischen verschiedenen Zuständen eines Objekts, postulieren und Abhängigkeiten solcher Übergangswahrscheinlichkeiten von Zuständen dieses oder anderer Objekte vermuten können. Dies erlaubt natürlich gleichwohl die Rekonstruktion des Prozesses und auch eine Axiomatisierung der zugrundeliegenden Theorie. Ein empirischer Test jedoch, ob eine bestimmte Rekonstruktion eines Prozesses in einem komplexen System besser ist als eine alternative Rekonstruktion, wird äußerst schwierig, weil Messungen nur für eine Realisierung des Prozesses möglich sind, während die Rekonstruktion stochastischer nichtlinearer Prozesse (die sich möglicherweile zugleich stochastisch und chaotisch verhalten) eine breite Vielfalt möglicher Verhaltensweisen zeigt.

Während die Falsifikation einer deterministischen Theorie so etwas wie gewisses (wenn auch negatives) Wissen hervorbringt, mag die Falsifikation einer stochastischen oder nichtlinearen Theorie nicht einmal möglich sein, weil der empirisch beobachtete Pfad des modellierten Prozesses einfach nur eine sehr geringe Wahrscheinlichkeit hatte — und in den Sozialwissenschaften sind wir normalerweise in der Situation, daß wir kein Experiment unter den gleichen Bedingungen wiederholen können — weil im allgemeinen jedes Experiment die Ausgangsbedingungen für das nächste Experiment verändert.

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Papers submitted for the sessions on Microsimulation, 13th World Congress of Sociology, Bielefeld

Organized by Ulrich Müller and Klaus G. Troitzsch

1. Explanation, Forecasting, and Policy Simulation with the Darmstadt Micro-Macro Simulator

Hans-Dieter Heike[1]

This paper presents first results of the Darmstadt Micro Macro Simulator (DMMS). The demographic part of the household micro simulator is used in connection with the macro simulator to forecast / project the foreseeable economic development of the new states of the Federal Republic of Germany. The application is subdivided into a short-term forecast of 1994/1995, a medium-term projection of 1997 and a long-term projection of 2002. The forcasts / projections use indicators to show the development of production, income, productivity, unit costs, income distribution, employment, and of the total government budget. A slow but significant economic convergence of the old and the new states is demonstrated in a status quo simulation using the most probable scenario of assumptions regarding demographic changes, international trade, technical development, and the strategies of economic policy.

2. What Makes the Difference Between Unsuccessful and Successful Firms in the German Mechanical Engineering Industry? A Microsimulation Approach Using Data from the NIFA Panel

Joachim Merz, Hiltrud Niggemann, Ulrich Widmaier[2]

For the small and middle sized German manufacturers economic success becomes more and more difficult given the rising costs and the increasing international competition. Despite this general trend a number of firms is performing economically very well (indicated by increase in employment, higher turnover and the degree to which production capacities are utilized) and hence we want to identify the specific combination of factors which causes this success.

In general simulation is a useful tool to study the dynamics of systems. Micro-simulation specifically requires a database which describes the characteristics of the so-called micro-units. In our study this database consists of a sample of about 1,500 firms in the German mechanical engineering industry with more than 20 people employed.

The model specified in the paper measures success of a firm as the degree to which it uses its production capacities both in terms of machinery and in terms of manpower. Independent variables are the use of computer-based technology, specific product and market strategies and the type of organization employed in the production process. In this micro-simulation approach the goal is not to identify a parametric function between independent and dependent variables but to demonstrate the changes necessary in the independent variables to achieve a predetermined level of success (i.e., a 100 % utilization of production capacities). It is important to note that success in this analysis does not mean individual success of a single micro-unit but success of the average of all firms. Thus individual values must always be interpreted in relation to the mean. Strategies which prove to be successful for a single firm can be detrimental for a large number of others and vice versa.

Attempts are made to identify those strategies which guarantee the greatest number of firms to "survive" under the restriction of the predetermined level of success. On the basis of these results we finally try to formulate a number of policy recommendations.

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3. Policy analyses with the Frankfurt Microsimulation Model: the Old Age Pension System

Heinz P. Galler[3]

The paper presents a microsimulation approach that has been used to evaluate reform proposals for the dependent's benefits in the German old age pension system. The intention of these proposals is to substitute widows' pensions that are derived from the pension claim of the deceased by an individual claim of the surviving spouse that is based on contributions. Both the impact of the proposals on revenue and expenditures of the system and on the personal distribution of income have been evaluated using a revised version of the Frankfurt microsimulation model. The paper reports on the data base and the structure of the model, on the simulation approach adopted, and on the main results that have been achieved.

4. A Microsimulation Model of Long-term Unemployment

Georg Müller[4]

During the past years, long-term unemployment has become a major problem of most industrial societies, entailing serious consequences for the public welfare budgets as well as for the individuals concerned. Since it affects different social groups, as defined by professional qualification, age, sex, marital status, nationality, etc., in different ways, a microsimulation model has been developed which attempts to explain the dynamics of social composition of the long-term unemployed.

The model proposed is based on the idea of a waiting queue of unemployed persons. The place of an individual in this queue is determined by professional qualification, status variables such as age, sex, nationality, etc., duration of umemployment, and random factors. At regular intervals the best placed persons of the queue are able to find a job, where the number of people concerned is taken from the public statistics. Simultaneously, an externally given number of persons lose their job and enter the queue which has consequently to be reordered according to the criteria mentioned before. Hence it is possible each quarter to calculate statistics on the social composition of the unemployed.

The model will be applied to several regional labour markets of Switzerland in order to test its functioning with empirical data, make forecasts on long-term unemployment, and study measures for alleviating social problems related to unemployment. For this purpose, a computer program has been developed which allows to simulate the behaviour of the model for different sets of parameters.

5. Modelling changes in Eastern and Central Europe

Andrzej Nowak, Leszek Zienkowski, Jakub Urbaniak[5]

Social and economic transitions often occur in an abrupt, rapid, and nonuniform manner, similar to phase transitions in physics–"bubbles of new" appear in the sea of "old". Computer simulations using cellular automata show that a bubble begins to form when a given element becomes more likely to change to a new position if it is surrounded by other elements that have themselves changed. The success of the transition depends on how effectively clusters of "new" grow and become interconnected. The theoretical model is supported by data concerning economic growth in Poland from 1989 to 1992, revealing that new businesses are created in regions where there are existing businesses and that such clusters expand to neighboring regions. In other regions, economic decline occurred despite the global growth of the national economy. Growing diversity in the societies of Central and Eastern Europe is due to a self-induced division into the "bubbles" of the "new" and "old." Growth of the "bubbles" of the "new" and the resistance of the "old" can be understood in terms of cluster growth and survival. The fate of individuals, both in the social and in the economic sense, depends to a large degree on their local environment. In the society composed of clusters, global indicators might be very misleading, since they may average the thriving clusters of new and decaying clusters of old. Practical implications concerning how to facilitate economic transition follow from the model.

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6. Coups Don't Just Happen — the Theory of the Individual in Coup Models and Simulation

Nicole S. Saam[6]

An idiographic system model on the sequence of military interventions and democratization in Thai politics from 1932 to 1992 is presented. The dynamics of military intervention has to be seen as a self-organizing phenomenon of a multilevel system. Members of military and civil elite interact in response to political, social, and economic macrodynamics and influence macrodynamics by political action. The theoretical model connects hypotheses of conventional macroscopic coup theory with new conflict theoretic approaches of democratization and Lindenberg's framing theory. The theoretical model was transformed into a semiquantitative multi-level model — individuals interact by master equations in a system dynamics environment — and implemented in the simulation software MIMOSE. Empirical data on the political, social, and economics of Thailand, 1932–92, was included for exogenous variables, and alternative micro and macro hypotheses were tested to reproduce Thai military intervention dynamics and evaluate the model. Finally, model experiments were made to find new hypotheses on the democratization process of Thailand.

7. Conditions for and forms of instability in outcomes of decision-making in policy networks

René Torenvlied, Andreas Flache[7]

In this study we explore the implications of a rational-choice model for stability of decision outcomes. The study is purely theoretical. We base our analysis on a computer simulation model developed and tested recently (Stokman F.N.; J.M.M. Van den Bos. 1992. A two stage model of Policymaking with an empirical test in the U.S. Energy-Policy domain. Research in Politics and Society, Vol.4. 219-253.). This model is based on the assumption that political actors strive to optimize decision outcomes by the exertion of influence on decision makers. The policy network is both, a resource and a restriction for influence activities.

We extended the model for our purposes. We add the assumption that actors' salience for the issue at stake changes with the outcome they expect. It is plausible to assume that the more unfavorable the decision outcome seems to be the higher the salience of the actor. We studied the implications of this assumption using a computer simulation approach. The major result is that under certain conditions the outcome of the decision making process is predicted to be extremely unstable. We could identify two necessary conditions for instability. First, there are at least two actors with opposing policy positions and whom others actors find it hard to influence. Second, actors are sufficiently intolerant with regard to deviations from their most preferred decision outcome. The latter parameter, intolerance, is decisive for the dynamics that result. All of the following types of dynamical patterns could be derived. A stable equilibrium, simple oscillation between two different outcomes, a complex oscillation and finally erratic and irregular dynamics.

8. Simulation and Structuration Theory

G. Nigel Gilbert[8]

One of the continuing problems of the social sciences is how properly to conceptualise the link between micro and macro level phenomena. This issue is the main topic of debate between methodological individualists and methodological holists. Recently, there has been a move to reject both of these positions in favour of a theory of 'structuration'. However, a precise definition of structuration has been elusive.

These conceptual problems of sociology are mirrored by current duscussions about the notion of 'emergence' in relation to the computer simulation of social phenomena. This paper considers, first, whether the sociological debates, in particular structuration theory, can shed light on the problem of emergence in computational systems. As a result of comparing sociological problems with existing simulations of human societies, I argue that the latter fail to model one of the fundamental features of human societies,

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a feature that is made apparent in structuration theory: that members of human societies have the ability to monitor and orient to the emergent features of their own societies. The implications for the development of social simulations are considered. Second, I suggest that recent work on social simulation, especially that in which actors are modelled using an approach based on distributed artificial intelligence, has metaphors to offer that can help in understanding macro/micro linkages.

9. Simulating the interaction between ecological dynamics and decision making process

François Bousquet, Christophe Cambier[9]

During the last twenty years the sustainable use of renewable resources by human societies has become an important field of scientific research. The main problem is to understand how different access rules to the resource may change both ecological and social dynamics. In this paper we try to discuss the idea that multi-agent simulation is an effective tool to study this problem.

Multi-agent simulations are used to represent complex situations in which individuals have different behaviours and to analyse the global situation as emergent structures of interaction. On the one hand, one can model numerous and simple agents who sense and react to their context. On the other hand, one can model agents with a set of belief and goals, with a representation of their environment and who reason and communicate with one another. Thus the method can be used to test various hypotheses on the individual decision making process. The viability of the man-nature relation is observed according to these hypotheses.

We present some experiments concerning the relation between groups of individuals and a fish community. We compare the different rules of access to the resource: economic rationality, ethnic rules of space sharing, protected areas, fishing licenses. We highlight the consequences of these hypotheses on the dynamics of fish community and on social evolution. Finally we discuss the validation of these simulations and we examine the idea that simulation may be used to participate in the reflection on social determinism or individual autonomy.

10. Emergence and Dreaming Routes in Aboriginal Australia: A Multi-Agent and Cognitive Approach

Jean Pierre Treuil[10]

The Australian Aborigines and their "Dreaming routes" present interesting features of spatial structures and representation of space.

These routes represent the journeys of the mystical Ancestors of various local groups. They connect series of places identified as tracks left by the Ancestors. Their networks correspond to collective mental maps which extend over most Australia.

The paper presents simulations which aim at exploring the conditions regulating such a structuration of space. It benefits from discussions with Barbara Glowczewski, C.N.R.S. anthropologist working on aboriginal societies.

One assumes that shared representations inside human groups emerge from interactions through which individuals transmit, interpret, and memorize information. The process depends on basic questions: who transmits to whom? what is transmitted? how is it memorized?

Considering this framework, the way of sharing spatial knowledge between individuals proposed here is the "life story", a narration of episodes memorizing the passage of an individual in a place (description of the place, people he has met, ...): Individuals can keep in mind a limited amount of life stories and transmit them to the people they meet. The explanations of how a structuration emerges are sought within few local rules of memorization and decision-making (for instance, preferences to keep in memory live stories of a given category of people, ...).

The method consists in testing diverse hypotheses through simulations with a multiagent (SmallTalk) system, which exhibits the dynamics of an artificial wandering society. One analyses the convergence of the processes towards collective mental maps and connected network of journeys.

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11. A Probabilistic Foundation of Social Force Models for Behavioral Changes

Dirk Helbing[11]

It is shown that BOLTZMANN-like equations allow the formulation of a very general model for behavioral changes. This model takes into account spontaneous (or externally induced) behavioral changes and behavioral changes by pair interactions. As most important social pair interactions imitative and avoidance processes are distinguished. The resulting model turns out to include as special cases many theoretical concepts of the social sciences, for example, the multinomial logit model, the logistic equation, the gravity model, and the game dynamical equations. A KRAMERS-MOYAL expansion of the BOLTZMANN-like equations leads to the BOLTZMANN-FOKKER-PLANCK equations which allow the introduction of "social forces" and "social fields" related to an idea of LEWIN. A social field reflects influences of norms, the public opinion, trends, and the environment on behavioral changes. To a large extent it is given by the interactions of the individuals. Variations of the individual behavior are taken into account by diffusion coefficients. The force model can, for example, be applied to the behavior of pedestrians.

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12. Computer Simulation of a Dynamic Force Model for the Behavior of Pedestrians

Péter Molnár[12]

A simulation model for the dynamic behavior of pedestrian crowds is developed on the basis of the following assumptions for the individual pedestrian movement: Each pedestrian wants to walk with a certain desired speed in direction of his or her next destination. A deviation from the desired velocity causes the individual to accelerate. Each pedestrian keeps some distance from borders, i.e. from streets, walls, and obstacles. Each pedestrian tries to avoid other pedestrians that are in the way. As long as an avoidance manoeuvre is not possible, the pedestrian decelerates or stops.

These assumptions can be mathematically formulated in terms of a force model, i.e pedestrians behave in a way as if they would be subject to an acceleration force and to repulsive forces describing the reaction to borders and other pedestrians. The computational simulations yield many realistic results that can be compared to video films of pedestrian crowds. E.g., they show the self-organization of macroscopic spatial or temporal patterns like the development of lanes (groups) consisting of pedestrians walking into the same direction, osciallatory changes of the walking direction at narrow passages, and a spontaneous formation of roundabout traffic at crossings. These patterns arise due to interactions of the pedestrians, but they are not the effect of strategical considerations of the individual pedestrians.

The developed model can be applied to the optimization of pedestrian flow in buildings, (underground) stations, pedestrian areas, etc. It can be extended by a route selection algorithm taking into account the pdestrians' needs. The finished simulation program will provide an extensive and comfortable tool for town planning.

Helbing, Dirk (1991): A mathematical model for the behavior of pedestrians. In: *Behavioral Science* **36**, pp. 298–310.

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13. Social Morphogenesis and Fatal Realization of Forbidden Evolutionary Ways

Igor V. Chernenko[13]

Human activities are limited by fundamental natural or social laws which are usually treated as principles of prohibition.

The main sociological principle of prohibition can be formulated as follows: violent restrictions of social freedom and pernicious coercion metamorphose deep functional structures of society and cause delayed-action fatal troubles that can be followed by a collapse of civilization.

Society evolves and undergoes transmutations driven by hidden nonlinear functional links between basic processes of social self-reproduction. Concealed nonlinear nature of social system can be revealed by means of mathematical modelling that enables one to reconstruct regularities of seemingly arbitrary social phenomena.

The micro level of a socio-economic system is described by the model of technological evolution based on Eigen's hypercycle, Allen's production functions and dissipative modifications of Lotka-Volterra equations.

This model was proved to be useful to simulate Kondratieff's long waves and macro effects of technological innovations on the micro level as well as hidden functional reasons of political crises, wars, and ethnic conflicts.

The macro level is described by Cusp Catastrophe model as three-dimensional image of multidimensional micro level. The macro model can be deduced from the micro description by means of Kuz'min's metabolism function.

Analyses of the micro model enable us to study hidden processes such as the strange attractor and the tunnel junction through the macro potential barrier that can be treated as a transition from socialism to post-socialism.

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14. Sociogenetics: Selforganization Aspects of Evolution in Social Systems

Mikhail V. Kuz'min[14]

The paper is devoted to investigation into the evolutionary growth of social system, treated as a biological, social and economical phenomenon in synergetic unity of all aspects of human activities.

Sociogenetic ideas of N. Kondratieff, F. von Hayek's concepts of social self-organization and historical interpretations of F. Braudel have found their novel life in models.

The models are elaborated on the basis of hypercyclic connectivity of human activities into a functional prestructure with posterior unfolding of deep-rooted potentialities during the process of evolutionary growth.

It is supposed that Eigen's hypercycle does not only describe the origin of life but processes in social life as well. The special role of Jung's archetypes as social genome is argued.

The development of social system is a sequential set of transitions between stable stationary states in the course of system growth. The system demonstrates behavioral metamorphoses, diversification, hierarchical transformations. The macro-space of discovered integrative characteristics (System Metabolism, Technogenic Connectivity, and Global Property) is constructed to observe evolutionary scenarios. Introduction of Relaxation Time enables us to judge system stability on evolutionary trajectories. The macro projection of micro processes is realized into cusp catastrophe surface under some conditions.

As a result the following complex dynamic effects in society are described: successive appearances of new aspects of production as bifurcation transitions, parabolic long-time oscillation of system metabolism, nonlinear logic of investment. The investigation yields the necessary conditions of social self-organization and economic effectiveness. The ways to unlimited growth are demonstrated.

Argumentations and conclusions are strengthened by computer simulation and statistics.

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15. Information Interaction, Morphogenesis, and Evolution in Social and Ecological Systems

Serge Chernyshenko[15]

Differential models of information interaction and information evolution in social and ecological systems are proposed. The models are based on suppositions that information processes have an essentially discrete and nonlinear nature. The typical characteristic of these processes is the following: signals with low power level may produce non-equivalent high-power reaction [Set 75]. From the other point of view this means a possibility of change-over of some parameters of system-receiver as a result of small changing (near some critical values) of system-transmitter characteristics. Thus, the information process may be interpreted as a sequence of bifurcations. If a global system including both receiver and transmitter is considered, we shall use the term "internal catastrophe" [Che 93]. In this case the bifurcation parameter of one sub-system is a phase coordinate of the other sub-system.

In accordance with this idea it is possible to synthesize various differential models of information processes in social and ecological phenomenona. The model of "predator-prey" (or "supply-demand") information interaction may be presented as an example of such model:

$$\left\{ \begin{array}{lll} \dot{v} &=& a(t)v(v - v^*) \\ \dot{V} &=& A(t)(V - \overline{V})(V - \overline{\overline{V}}) \\ \dot{x} &=& p(t)v \qquad \dot{y} \;=\; q(t)v \\ \dot{X} &=& P(t)V \quad\; \dot{Y} \;=\; Q(t)V \end{array} \right.$$

Another synergetic model of an information process is the model of societal evolution [CCC 88] based on M. Eigen's Hypercycle [ES 79]. As a result of "internal catastrophes" the information capacity of the system increases. It is a good illustration of information increasing process in open systems.

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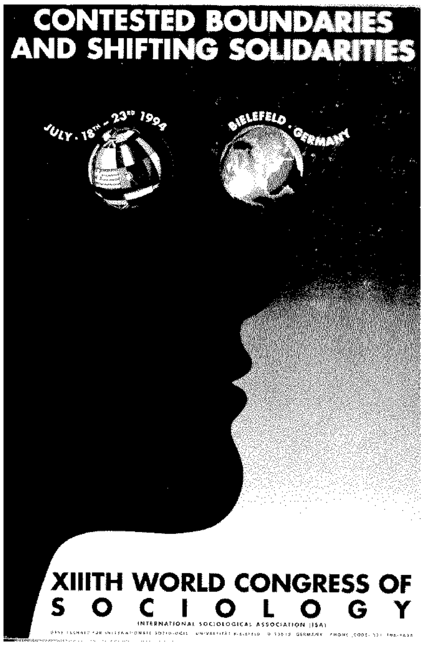

Abbildung 1: Das Logo des XIII. Weltkongreß der Soziologie in Bielefeld, 18.–24.Juli 1994.

Kommentar

Es tut sich was an der Front der Computer-Simulation in der Soziologie. Zweifelsohne bestehen da sowohl Nachholbedarf als auch gute Chancen, einzelne Phänomene zu beschreiben oder auch vorherzusagen. Trotzdem sollte man sich bewußt sein, daß im allgemeinen noch das Problem bleibt, die freien Parameter in den Modellen aus Zeitreihen zu bestimmen. Selbst wenn das Aufstellen einer vernünftigen Gütefunktion möglich ist, bleibt das allgemeine Problem der Suche nach den optimalen Parametern ein NP-hartes Problem. [16]

In einem mir bekannten Modell gibt es noch 150 freie Parameter, nachdem die übrigen durch Anwendung soziologischer Kenntnisse bereits eliminert wurden. Um die Suche zu vereinfachen werden jeweils nur 5 verschiedene Werte pro Parameter untersucht. Ein Simulationslauf braucht etwa 1000 CPU-Sekunden. Nach $5^{150} \cdot 1000 sec = 7 \cdot 10^{107} sec \approx 2 \cdot 10^{100}$ Jahren weiß man dann, welche Parameter am besten die Zeitreihe wiedergeben. Ein $2 \cdot 10^{15}$ mal schnellerer Rechner, der eine Simulation in einer Picosekunde liefert, braucht immerhin noch 10^{85} Jahre, also auch viel länger als das Alter des Universums[17]

Solange es nicht gelingt, der soziologischen Dynamik eine mathematische Spezialität nachzuweisen, die den zugehörigen Optimierungsproblemen ihre NP-Härte nimmt, bleiben diese Systeme zu komplex, im negativen Sinne: zu kompliziert.

Werner Eberl

[16] Man könnte meinen, daß die Anwendung eines Least-Square-Fit zu einem linearen Problem führt, das in endlicher Zeit lösbar ist. Dies geht aber nicht, wenn man eine zugleich nichtlineare und verrauschte Zeitreihe vor sich hat. Man muß dann entweder problematische Annahmen über das Rauschen treffen und/oder alle Stellen, in denen Modellparameter nichtlinear in das Modell eingehen umformulieren. Dazu braucht man dann viele weitere Parameter, was die Konditionszahl der zu lösenden Matrizen des entstehenden Gleichungssystems so dramatisch verschlechtert, daß man die Parameter wieder genausogut auswürfeln kann.

[17] Selbst wenn man jedes Atom im Weltall zu einem solchen Rechner umbaut, wird das Ergebnis noch nicht erwartbar, auch nicht für Luunquoal oder die Mäuse Benjy und Frankie.

Ordnung und Quantenchaos

Bericht von Ulli Köster vom WE-HERAEUS-Ferienkurs für Physik

Vom 12.9. bis 24.9.93 fand an der TU Dresden ein Ferienkurs über Ordnung und Quantenchaos mit zahlreicher und namhafter Beteiligung statt. 14 Hauptreferenten hielten einen meist 2 mal 2 Stunden dauernden Vortrag. Daneben bekamen die etwa 50 auswärtigen Teilnehmer (Studenten und Doktoranden aus Deutschland und der Schweiz) und viele Tagesgäste aus Dresden noch über 20 Kurzreferate zu speziellen Themen zu hören. Abgerundet wurde das Programm durch Ausflüge in die nähere Umgebung (Sächsische Schweiz, Forschungszentrum Rossendorf).

Die einzelnen Vortragsthemen waren zwei Hauptgebieten zuzuordnen: Quantenchaos und Chaos im weitergefaßten Sinn (Synergetik, Turbulenz,...) sowie Kernphysik. Im Verlaufe der Vorträge zeigte sich, daß diese beiden Gebiete doch sehr viel mehr miteinander zu tun haben, als man zuerst vermutet. Eine Vielzahl von Effekten des Quantenchaos wurde erläutert, die unter anderem Namen schon lange in der Kernphysik bekannt sind.

Über die experimentelle Untersuchung des Quantenchaos (hauptsächlich zweidimensionale Billards, die sich durch Hohlraumresonatoren mit supraleitenden Wänden simulieren lassen) berichtete Prof. Smilansky vom Weizmann Institute (Israel). Prof. Walther vom Max-Planck-Institut für Quantenoptik (Garching) hielt einen sehr interessanten Vortrag über chaotische Systeme in Quantenoptik und Atomphysik (z. B. Rydbergatome in starken Feldern).

Sozusagen der Höhepunkt der theoretischen Vorträge war der von Prof. Steiner (Uni Hamburg), der dabei Verbindungen von der **Quantenchaologie** zu Zahlentheorie und QCD herstellte.

Der Ferienkurs, der von Prof. Rotter (FZ Rossendorf) und Prof. Freiesleben (TU Dresden) mit viel Engagement organisiert und von der WE-Heraeus-Stiftung finanziert wurde, bot reichlich Gelegenheit, sich über die neuesten Erkenntnisse zu informieren und „interdisziplinäre“ (innerhalb der Physik) Kontakte zu knüpfen.

Folienkopien der Hauptvorträge können über die Chaosgruppe bezogen werden.

A nonlinear model of population growth and renewable resources

Alexia Prskawetz[18], *Gustav Feichtinger and Franz Wirl, November 1993*

1. Introduction

"Two grand themes pervade macro-demographic theory: the *Malthusian* one, that population equilibrates with resources at some level mediated by technology and a conventional standard of living; and the *Boserupian* one, that technological change is itself spurred by increases in population" (Lee, 1986). In this paper we examine the behaviour of a system governed by the mechanisms of the first theory.

Malthus (1798) was the first to succeed in systemizing an economic theory of population growth. Tunzelmann (1986, 1991) regards Malthus to be the first great evolutionary economist. Special features, unique to Malthus's population system, include (i) a belief in the importance of non-linearity of structural relationships, (ii) an awareness of the complicated, multi-connected nature of those structural relationships, (iii) given due consideration for time, in both,the durational and historical senses and (iv) the study of the system out of equilibrium. To incorporate these distinct characteristics we will make use of the theory of *nonlinear dynamical systems*.

Contrary to Malthus, who assumed that manufactures could be treated similarly to agriculture, we will consider a *demo-economic model* with *two distinct sectors*.

Futhermore we will focus on the interaction between resource exploitation and population growth in a dynamical framework. In the spirit of Malthus we add a feedback mechanism. Not only will more (effective) labour produce more ouput, but more output will in turn increase population. However, more output requires more resources, which may endanger the sustainability of the resources and therefore economic growth.

[0]This work was supported by a grant from the Austrian Academy of Sciences.

2. The model

The economy consists of two sectors. The *primary sector* uses available resources R and labour force P_1 to produce the output $H = H(R, P_1)$. The *secondary* or *manufacturing sector*, uses the labour force P_2 and the output H of the primary sector to produce finished output $Y = Y(H, P_2)$. This output Y determines the income per capita, $y = Y/P$ which in turn determines population growth endogenously. P equals the sum of P_1 and P_2.

In particular, we assume a Malthusian relationship [1] between population growth and the standard of living given by the output per capita y. As long as output per capita is below some exogenous given subsistence level y^{sub}, the population will decline, while a positive population growth rate will set in when output per capita exceeds y^{sub}. For analytic and numerical convenience we use the function:

$$n = b\log(y/y^{sub}) \quad (1)$$

where b represents a constant scaling factor. For simplicity we assume full employment, such that the labour size is equal to the population size.

The evolution of the economy, we are considering, can be expressed by two nonlinear differential equations in the variables R (stock of resources) and P (population)[2]:

$$\dot{R} = \frac{dR}{dt} = g(R) - H(R, P_1) \quad (2)$$

$$\dot{P} = \frac{dP}{dt} = Pn(y, y^{sub}) \quad (3)$$

The net growth of the renewable resource stock R is affected by two counteracting factors, in-

[1]As recently expressed by a well known political scientist (Kennedy, 1992) Malthusian forces are quite visible in many developing countries.

[2]Time arguments of the variables, e. g. $R(t)$, $P(t)$, are omitted in the following

digenous, biological growth $g(R)$ and the harvest H. According to the bulk of the literature (e.g. Clark, 1985) it is assumed that the growth function g is a logistic one,

$$g(R) = aR(\bar{R} - R),$$
$$g(R) > 0, g'' < 0 \quad \text{for} \quad 0 < R < \bar{R}$$

The coefficient $\bar{R}$ determines the saturation level of the resource stock and the parameter a determines the speed at which the resource regenerates.

For analytical and numerical convenience, we assume that both production functions H (harvest) and Y (industrial output) are of the Cobb Douglas form (Blanchet, 1991):

$$H(R, P_1) = BR^{\alpha_1}P_1^{\alpha_2}, \qquad 0 < \alpha_1, \alpha_2$$
$$Y(H, P_2) = AH^{\beta_1}P_2^{\beta_2}, \qquad 0 < \beta_1, \beta_2$$

where A and B can be regarded as scaling factors representing a fixed level of technical progress.

The whole economy is competitive in all output and input markets. Moreover, labour is a homogenous input to both industries and moves instantaneously to the sector with higher wages. Therefore, clearing of the labour market requires that both industries offer the same wage w.

From economic theory we know that perfect competition leads to output prices equal to marginal costs, which are determined by the wage w paid for one additional worker devided by his (marginal) product, H_{P_1}(Varian, 1984). [3]

$$p = \frac{w}{H_{P_1}} \tag{4}$$

The cost minimizing input allocation of the industry follows from the condition that the ratio of the marginal products must equal the factor prices:

$$\frac{Y_{P_2}}{Y_H} = \frac{w}{p} \tag{5}$$

Combining conditions (4) and (5) leads to the equality:

$$\frac{\partial Y}{\partial P_2} = \frac{\partial Y}{\partial H}\frac{\partial H}{\partial P_1} \tag{6}$$

[3]Subscripts denote partial derivatives of the function with respect to the corresponding argument.

Evaluating the derivatives in (6) and solving for P_1 and P_2 yields

$$primary \;\; sector: P_1 = p_1 P = \frac{\beta_1\alpha_2}{\beta_1\alpha_2 + \beta_2}P$$

$$secondary \;\; sector: P_2 = p_2 P = \frac{\beta_2}{\beta_1\alpha_2 + \beta_2}P$$

Thus, the specification of Cobb Douglas technologies allows for an explicit calculation of the labour shares p_1 and p_2 that are employed in the respective sectors. Note that this division of labour to the primary and secondary sector is not influenced by the production elasticity of the resources, α_1.

3. Phase Space Analysis

3.1 Stationary solutions

Besides the trivial solution $(R^*, P^*) = (0, 0)$ there may but need not exist a positive stationary point (R^*, P^*) defined by the intersection of the isoclines

$$\dot{R} = 0 \iff P = [\frac{a(\bar{R} - R)}{Bp_1^{\alpha_2}}R^{1-\alpha_1}]^{1/\alpha_2}$$

$$\dot{P} = 0 \iff R = [\frac{y^{sub}}{AB^{\beta_1}p_1^{\alpha_2\beta_1}p_2^{\beta_2}}P^{1-\alpha_2\beta_1-\beta_2}]^{1/(\alpha_1\beta_1)}$$

Note that the stationary solutions do not depend on the level of the population growth parameter b.

3.2 Stability analysis

The *local dynamical behaviour* of system (2) – (3) can be examined by means of a linear expansion of (2) – (3) at the equilibrium point (R^*, P^*). The Jacobian matrix J, evaluated at the stationary solution (R^*, P^*) is defined as

$$J = \left(\begin{array}{cc} \dot{P}_P & \dot{P}_R \\ \dot{R}_P & \dot{R}_R \end{array} \right)\Bigg|_{(R^*, P^*)} \tag{7}$$

and the elements are given by $\dot{P}_P = n + Pn_P$, $\dot{P}_R = Pn_R$, $\dot{R}_P = -H_P$, $\dot{R}_R = g' - H_R$. The eigenvalues of (7) are:

$$\lambda_{1,2} = \frac{1}{2}(trJ \pm \sqrt{(trJ)^2 - 4detJ})$$

where trJ denotes the trace of the Jacobian J and $detJ$ its determinant.

Evaluating the derivatives of the Jacobian matrix (7), we obtain:

$$\begin{aligned} n_R &= b(\alpha_1\beta_1)(R^*)^{-1} \\ n_P &= b(\alpha_2\beta_1 + \beta_2 - 1)(P^*)^{-1} \\ g' &= a(\bar{R} - 2R^*) \\ H_R &= B(P_1^*)^{\alpha_2}\alpha_1(R^*)^{\alpha_1-1} \\ H_P &= B(R^*)^{\alpha_1}p_1^{\alpha_2}\alpha_2(P^*)^{\alpha_2-1} \end{aligned}$$

The derivatives n_R, H_R and H_P are always positive. The sign of the derivative n_P switches from positive to negative depending on the term $(\alpha_2\beta_1 + \beta_2 - 1) > (<)0$. In the case of CRS production functions, this term will always be negative. Hence, only if one of the production functions H or F exhibits increasing returns to scale (IRS), i.e. $(\alpha_1 + \alpha_2) > 1$ or $(\beta_1 + \beta_2) > 1$, will the effect of increasing population be positive on the growth rate of population (the derivative n_P will be positive).

Finally the derivative g' switches also its sign, being positive (negative) if $\bar{R} > 2R^*$ ($\bar{R} < 2R^*$).

As long as trJ is negative, stable solutions will result (either converging monotonically if the discriminant is positive or exhibiting damped oscillations in the case of a negative discriminant). Our purpose is to find the conditions under which the system changes its stability, i.e. when trJ becomes positive. In particular we investigate the conditions of a HOPF BIFURCATION, i.e. when the fixed point of our system bifurcates into a closed orbit in a neighbourhood of the equilibrium.

In order to demonstrate the existence of a Hopf bifurcation in a concrete system it is sufficient to show that

1. there exists a pair of pure imaginary eigenvalues and no other eigenvalues with zero real parts.
2. $\frac{d(Re\lambda(\mu))}{d\mu}|_{\mu=\mu_0} > 0$

Furthermore the stability of the closed cycles has to be determined along with the sign of the Ljapunov number in the normal form of the system. (see, e.g. Lorenz, 1989, p.75 ff; Guckenheimer and Holmes, 1986, p.150 ff).

Since population growth equals zero at equilibrium, we get the following condition for the trace to be zero:

$$\begin{gathered} trJ = 0 = Pn_P + (g' - H_R) = \\ b(\alpha_2\beta_1 + \beta_2 - 1) + a(\bar{R} - 2R^*) - \\ B\alpha_1(P_1^*)^{\alpha_2}(R^*)^{\alpha_1-1} \end{gathered}$$

The third term is always negative, while the first and second term are either positive or negative. But in order for the trace to vanish, the sum of the first and second term needs to be positive. Therefore two different routes can counterbalance the negative element above such that $trJ = 0$ and cyclical patterns are possible:

Route 1: Increasing returns to scale and moderate growth of the resource stock *that falls below its marginal product, i.e. $(g' - H_R) < 0$. The economic explanation is that in a stationary economy increasing returns to scale provide a means to evade - temporarily (limit cycles) or forever (exploding spirals) - Malthus' stationary solution at the subsistence level.

Route 2: Constant returns to scale but large growth of the renewable resource stock such that the growth outweighs the marginal product, i.e. $g' > H_R$. [4] This in turn requires an equilibrium $R^* < \bar{R}/2$. The economic intuition behind this finding is that low resource stocks reduce the marginal product of labour such that few people are employed in the primary sector. Due to g' large, the resource grows, while attracting more and more people. As a consequence the associated harvest reduces the resource stock and the cycle starts again.

Furthermore the condition for the determinant

[4] A casual reader acquainted with this logistic map g may suspect that the specification of logisitc growth is essential. This however is not the case, because the condition $g' > H_R > 0$ is crucial, and not the logistic specification. And this condition can be met by many biological growth functions, even linear growth.

to be positive yields the inequality:

$$B(P_1^*)^{\alpha_2}(R^*)^{\alpha_1-1}(\alpha_1\beta_2-\alpha_1) <$$
$$(\alpha_2\beta_1+\beta_2-1)a(\bar{R}-2R^*)$$

4. Numerical Stability Analysis

In this section we will numerically investigate the existence and stability of the equilibria using the interactive LOCal BIFurcation program LOCBIF (Khibnik et al., 1993).

We start our analysis with the following set of parameters: $\alpha_1 = \alpha_2 = \beta_1 = \beta_2 = 0.5, \bar{R} = 5, B = 1, a = 1, A = 1, b = 1, y^{sub} = 1$. This assumption implies CRS production functions, which enables us to solve directly for the nontrivial stationary solution. With the above given set of parameter values this yields the equilibrium point $(R^*, P^*) = (4.\dot{7}, 0.7078189)$,which will provide a starting point to compute *equilibrium curves*. These curves are defined in the phase-parameter space of our model (2)– (3) by $\dot{R} = 0$, $\dot{P} = 0$ where all parameters but one are fixed.

In Figure 1, the equilibrium curves for the resources and the population have been computed, if the production elasticity of Y with respect to H,β_1, is varied.

By choosing β_1 to vary we aim to numerically illustrate the first route to possible limit cycles.

All points along the curve in Figure 1 correspond to stationary solutions. The higher β_1 , the lower the resource stock will be in the long-run. As Figure 1a shows, a moderate decline in resources for values of β_1 up to 1 will be followed by a sharply decrease in resources for values of β_1 larger than 1. A higher production elasticity β_1 induces the secondary sector to shift its inputs away from labour towards the output of the primary sector H. Once the production elasticity β_1 exeeds the value 0.5, the economy faces IRS in producing the output Y. This leads to an overexploitation of the renewable resource stock R (R will decrease), followed by a decline in the output Y and the population level P for values of β_1 exceeding 1.2 (Figure 1b).

Varying β_1 not only changes the level of the

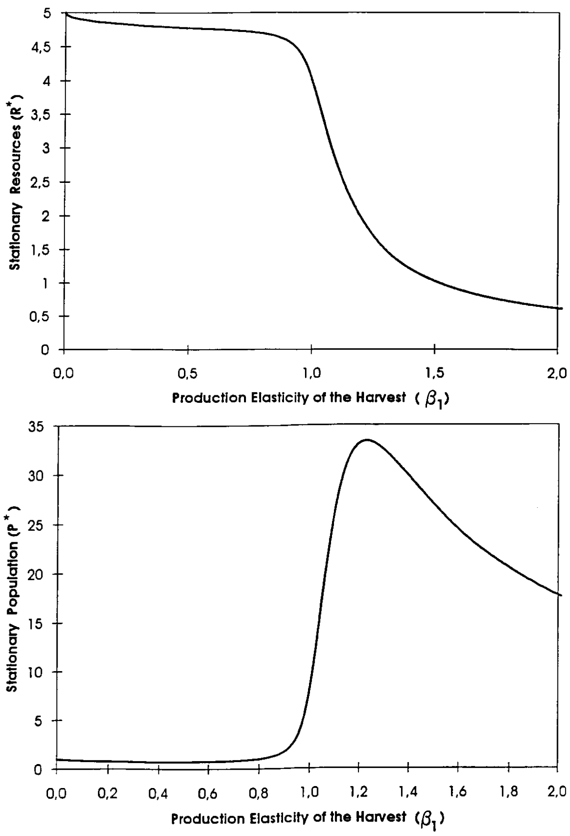

Figure 1: Equilibrium curves if we fix $\alpha_1 = \alpha_2 = \beta_2 = 0.5, \bar{R} = 5, A = B = a = b = y^{sub} = 1$ and let β_1 be the bifurcation parameter

stationary solution, but also its stability. In particular two bifurcation points are located on the equilibrium curves in Figure 1. At $\beta_1 = 1.108738$, a double eigenvalue (a pair of real and equal eigenvalues) emerges, which defines a border along which a monotone decay to the equilibrium is replaced by the oscillatory type decay. Further increasing of β_1 yields a Hopf bifurcation point at $\beta_1 = 1.241708$ with a negative Ljapunov number $L_1 = -.624364E-2$ indicating the existence of a stable limit cycle (supercritical Hopf bifurcation), which arises for values of β_1 greater than the Hopf bifurcation point.

These two bifurcation points can be taken as inital points for a double eigenvalue curve and a Hopf curve in a phase-parameter space, where all but two parameters are fixed (see Khibnik et. al, 1993). Additionally to β_1 one of the other exogenous given parameters has to be varied. Though we performed all possible combinations, we just present the outcome of changing y^{sub}, additonally to varying β_1.

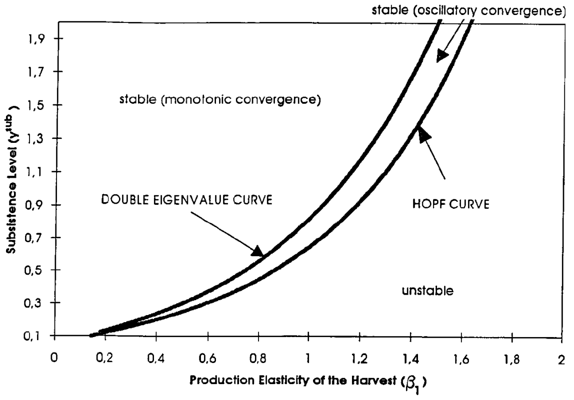

Figure 2: Bifurcation curves if we fix $\alpha_1 = \alpha_2 = \beta_2 = 0.5, \bar{R} = 5, A = B = a = b = 1$ and let β_1 and y^{sub} be the bifurcation parameters

The two curves in Figure 2 are implicitely defined by the conditions, that the eigenvalues of (7) are either real and equal (*double eigenvalue curve*) or purely imaginary (*Hopf curve*). These bifurcation curves trace out three regions of particular interest regarding the local stability of the stationary solution (R^*, P^*).

For example, if we start out from a fixed subsistence level between 0.1 and 2.0 and vary the production elasticity β_1 we pass first a region, where the system monotonically converges to a stable equilibrium. By crossing the double eigenvalue curve the pair of eigenvalues of the Jacobian of the linearized system becomes complex, but still having negative real parts, until we cross the Hopf curve. Hence the region between the double eigenvalue curve and the Hopf curve is characterized by stable oscillatory convergence. Further increasing the production elasticity β_1 leads to a Hopf bifurcation. A pair of pure imaginary eigenvalues emerges if we cross the Hopf curve. To the right of the Hopf curve the stationary solution becomes unstable, which is indicated by the positive real parts of the complex eigenvalues.

As Figure 2 shows, there exists a trade off between the subsistence level y^*, the production elasticity β_1 and the stability of the stationary solution (R^*, P^*). The higher the subsistence level, the larger will be the region of stability with respect to varying the production elasticity β_1 .

Therefore Figure 2 highlights implicitly that not only the first, but also the second route to limit cycles indeed facilitates a Hopf bifurcation.

If this subsistence level is used as a reference for zero population growth, then an increase of y^{sub} will stabilize the evolution. Put differently, the often erratic and cyclical patterns of low income countries would be reduced when y^{sub} increases.

5. Conclusions

The model proposed in this paper has two main features. Firstly, population is usually assumed to be independent of economic decisions. In the present model, however, population growth is endogenous and thus dependent on economic conditions. Secondly, modifying Malthus's model for explicit consideration of resources, we showed that the Malthusian trap may be reached other than monotonic and may be of a higher dimension than zero. In particular the equilibrium solution may be described by a limit cycle (that is an equilibrium of dimension one), which was shown by applying the Hopf bifurcation theorem. (For a more elaborate version of this paper see Prskawetz, A., Feichtinger, G. and Wirl, F., 1994).

We have characterized two routes to limit cycles. Increasing returns to scale, which is in contrast to the decreasing returns to scale assumption of Malthus's model (Lee, 1986), and sufficient high renewable resource growth, which is also different to Malthus's model of fixed resources.

Although it is difficult to compare the gains and losses of such cycles, compared to Malthus solution, we know that cyclical patterns may indeed be optimal (Benhabib and Nishimura, 1979; Dockner and Feichtinger, 1991).

Including further detail, that is, studying higher order description of economic and demographic interaction, may facilitate even more complex solutions. This is left to further research.

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The Global Brain as a Modeling Paradigm for Crisis Management

Gottfried Mayer-Kress and Cathleen Barczys

Abstract:

We discuss how the existence of a global and tightly connected network of computer workstations such as the Internet can lead to the emergence of a globally self-organized structure that we would like to refer to as the *Global Brain*.

Associated with that structure would be the capability for a class of highly distributed and interactive global models that can have a functional resemblance to how biological brains solve complex problems. Though this article emphasizes worldwide models for crisis management, the concept of a Global Brain and models which utilize the Global Brain can be applied in any research area where models that are more rapid and appropriate in their responses to ever-changing, non-equilibrium situations are desired. We first discuss some functional properties of biological brains and how their functional analog could be manifested in a Global Brain. We then present an eight-step process for constructing models which utilize the Global Brain. We review some of the tools that are currently available to make the information and simulation resources of the global Internet system accessible to researchers wishing to participate in the development of this type of model. We discuss some potential applications to regional crisis management that might result from this approach. We conclude with a consideration of some of the implications of a Global Brain. [5]

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Das gesamte Paper ist über WWW verfügbar: http://jaguar.ccsr.uiuc.edu/web/People/gmk/Papers/GlobalBrain

[5]To appear in Proc. of: **Chaos and Society**, Conf. Univ. du Quebec a Hul,Hull, Quebec, Ca, June 1-2, 1994

First INFFC: International Nonlinear Financial Forecasting Competition

Sponsors: NEUROVE$T Journal and Genesis Financial Data Services

1. Purpose

To test the performance of nonlinear technologies and machine intelligence applied to making financial predictions in an independent environment, to analyze and distribute results, and to establish a foundation for future work. Future work will include the test and analysis of these technologies applied to actual trading systems in a separate Competition.

The following Distinguished Panel of Analysts will analyze and judge results of the Competition:

E. Michael Azoff, Themisto Numerics Ltd. UK
J. Doyne Farmer, The Prediction Company
Gary W. Flake, Siemens Corporate Research
Donald Hush, University of New Mexico
Victor E. McGee, Dartmouth College
John Moody, Oregon Graduate Institute
Paul Refenes, London Business School
Timothy D. Sauer, George Mason University
Manoel F. Tenorio, Purdue University
Andreas S. Weigend, University of Colorado
Halbert White, Univ. of California at San Diego

2. Tracks

The Competition will include two Tracks: Scientific (disclosed) entries, Professional (non-disclosed) entries

3. Prediction Strategies

Three prediction strategies will be accepted (see Rules, #3):

- Tracking
- Recursive
- Price/Time Horizons

4. Details

Final details on the INFFC will be available from the Organizer by June 3, 1994.

4.1 Important Dates

Training Data Available:	June 3, 1994
Last Date for Registration:	June 24, 1994
Software Submission:	September 2, 1994
Competition Begins:	September 12, 1994
Paper Submission Due:	October 14, 1994

4.2 Important Adresses

Data Information and Registration:
Randall B. Caldwell (INFFC), P.O. Box 764, Haymarket, VA 22069, USA, rbcaldwell@delphi.com

Software Submission:
Manoel F. Tenorio (INFFC), Parallel Distributed Structures Lab, School of Electrical Engineering, Purdue University, W. Lafayette, IN 47907, USA

Paper Submission:
Randall B. Caldwell (INFFC), P.O. Box 764, Haymarket, VA 22069, USA

4.3 Contacts

CHAIRMAN:
Manoel F. Tenorio (INFFC), Parallel Distributed Structures Lab School of Electrical Engineering, Purdue University, W. Lafayette, IN 47907, USA, tenorio@ecn.purdue.edu

ORGANIZER:
Randall B. Caldwell (INFFC), P.O. Box 764, Haymarket, VA 22069, USA, rbcaldwell@delphi.com

5. Rules

1. REGISTRATION (see dates and addresses above):

In order to qualify for registration, ALL entrants must provide the following information by the registration deadline:

- Name
- Postal address
- Email address
- Telephone numbers (voice and fax)
- Affiliations
- Biographic sketch
- Qualifications
- Track (Scientific or Professional)
- Prediction strategy (Tracking, Recursive, Price/Time Horizons)
- Fees (if applicable)
- Overview (500 words) of the model to be applied in the Competition
- Computer platform (if applicable)

2. FEES:

There is no fee to register as a Scientific entry. Professional entries must include with Registration a check (U.S. dollars on a U.S. bank) or international postal money order for $200.00 made payable to: NEUROVE$T JOURNAL, P.O. Box 764, Haymarket, VA 22069 USA. Fees submitted are non-refundable.

3. FORECASTING:

All entrants must use ONLY the data provided to them by the INFFC to train, develop, test and apply any tools to be used in the Competition, and to make specific predictions for one or more of the financial time series to be made available.

Three types of Prediction Strategies will be accepted:

a. "Tracking" systems that generate fixed-window predictions: periodic data will be provided to entrants who will then update their forecasts and submit them.

b. "Recursive" systems that generate predictions using previous estimates: tests will be performed directly using executable code provided by the entrant.

c. "Price/Time Horizon" systems that generate occasional price or time predictions using a tracking approach. For example: Time : for a given time horizon, provide the predicted_price_change that will be reached before a significant reversal occurs (such as: -predicted_price_change/3). Price: for a given price_change horizon, predict the time that such price_change will be reached before a significant reversal occurs (such as: -price_change/3).

4. PAPER SUBMISSION (see dates and addresses above):

All entries

a. All entrants are required to provide a high-quality, edited Paper, in English, including a completed copy of the provided Copyright Transfer form by October 14, 1994 on the model applied to the Competition. Failure to provide the required Paper by the deadline will result in disqualification and forfeiture of any fees submitted.

b. Resubmit all Registration information.

c. All papers submitted will not be returned.

d. It is the author's responsibility to ensure that all papers submitted to the INFFC have received approval of the necessary employer, institution or other relevant authority, and have not been submitted for publication elsewhere. The INFFC publisher reserves the right to perform extracts from all papers submitted, and to edit papers for the purpose of making grammatical and typographical corrections and as necessary to meet space requirements.

e. Paper submissions must be provided in both hardcopy (3 copies, single-sided, double-spaced) and softcopy. The preferred media format is IBM PC DOS, 3.5", 1.44MB. The preferred file format is Word for Windows 2.0. Also acceptable is WordPerfect 5.0/5.1 or Macintosh Word 4.0/5.0 using the preferred media format. Also acceptable is any standard ASCII text file format using the preferred media format, and including bracketed notations for the locations of symbols, equations or other non-ASCII characters. Five or more graphics (charts, graphs, diagrams) illustrating the models and techniques applied to the Competition must be provided. The preferred softcopy format for graphics is in Windows compatible format (.pcx or .wmf format preferred). For other graphics formats, entrants must submit high-quality paper copies.

f. References must use the following formats:

Journal Article: authors' names, article title (in double quotations), periodical title (in italics), publication date and suffix (as necessary), volume and number, pages cited

Book: authors' names, book title (in italics), publisher, publisher location, publication date and suffix (as necessary), pages cited

Chapter in Book/Proceedings: authors' names, chapter title (in double quotations), editors' names, book title (in italics), publisher, location, publication date and suffix (as necessary), pages cited

Example:
Watson, John and Raymond McCoy, "Nonlinear Systems for Financial Forecasting," INFFC Publishing Co., New York, 1992a, pp.235-260.

Text citations must use the following formats: [last name of authors,publication date and suffix (as necessary)]
Example: [Watson,McCoy,1992a]

Scientific entries

Scientific entries must provide a Paper of 5000 to 7000 words to include specific details on their models and techniques used for the Competition, including: abstract, introduction, design, training and testing, implementation, architecture, operation, tradeoffs performed, data preprocessing, conclusions, references.

Professional entries

Professional entries must provide a Paper of 2000 to 4000 words. Specific model details are not required but, at a minimum, papers must include an abstract, introduction, general description of the models, training and testing, relevant discussion of techniques applied to the Competition, conclusions, references.

5. TECHNOLOGIES:

All entrants must use software that applies nonlinear techniques to making specific predictions using ONLY the data provided and according to Forecasting rules. However, a few entries that do not satisfy this criterion will be accepted by the Chairman for comparison with nonlinear techniques.

6. SOFTWARE SUBMISSIONS (if applicable, see dates and addresses above):

a. Entrants using the "Recursive" Prediction Strategy are required to submit executable software to the Chairman for testing by the INFFC. Software must operate on one of the allowable computer platforms: IBM PC DOS or Sun Sparc UNIX workstations. For other platforms, make inquiries to the Chairman.

b. Resubmit all Registration information.

c. Material submitted will not be returned.

d. Following the Competition, all material will be destroyed.

7. DATA (see dates and addresses above):

Training data to be used for the Competition will be available for free by anonymous ftp on the Internet, or by mail. For Training data provided by mail (supplied on 1.44MB, 3.5" IBM PC, MS-DOS format) entrants must include with Registration a check (U.S. dollars on a U.S. bank) or international postal money order for $10.00 made payable to: NEUROVE$T JOURNAL, P.O. Box 764, Haymarket, VA 22069 USA. Fees submitted are non-refundable.

8. WINNING ENTRIES:

The best Scientific entry for each of the three Prediction Strategies will receive a free copy of the INFFC Proceedings and a free subscription to the NEUROVE$T Journal. Of these best Scientific entries, an overall winner will additionally receive free software and books (product sponsors and product names to be announced June 3, 1994).

In The Clouds — The Easiest Way To Get Information To Your Desktop

G. Bauer[1] and W. Eberl

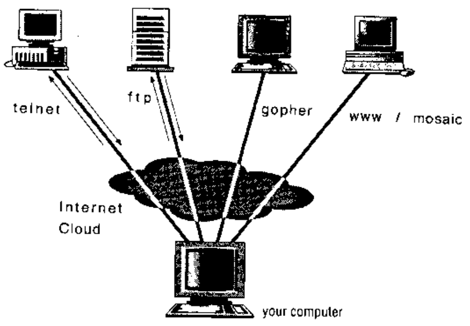

Figure 1: Using the Internet

1. What is The Internet?

- The Internet is the foot-path of the Information Highway – leading the way in linking information providers and users around the globe.
- The Internet is the network of networks which follow a set of rules known as the "Internet Protocol (IP)".
- The Internet links more than 2.2 million computer hosts in 70 countries; you can send electronic mail to about 150 countries - and these numbers are growing faster and faster.
- The Internet is neither run by any person nor any organization. Instead it is a collective effort of many (30000) organizations each responsible for some subset of the net with the shared goal of providing global communications and network services.
- The Internet can be used for
  - sending or receiving electronic mail
  - participating in special interest groups
  - reading or writing for electronic digests and journals
  - searching online library catalogs around the world
  - acquiring text and program files from remote computers

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Warning: Learning to use the Internet for research, business or pleasure takes a considerable investment of time and energy !!!

2. Basic and Advanced Internet-Tools (How do I get infos from the net ?)

2.1 telnet

• lets you connect to other computer systems
• you have to pass a login procedure requiring user ids and passwords

2.2 ftp

• transfers files from other computers to your computer (or vice versa)
• uses some simple commands for retrieving files (cd, get, put, bin)
• many sites allow anonymous ftp, so you don't need an user id

2.3 archie

• service to locate files in the net
• contains several millions of indexed file names from anonymous ftp-sites
• filename-database (names of documents or software packages)
• whatis-database (descriptions of documents or software packages)

2.4 gopher("universe of menues")

• allows users to explore, search and retrieve information distributed over the net

• distributed document delivery service using a client-server model
• employs a hierarchical outline to make browsing and searching sources of information quick and uncomplicated
• intermediate nodes are directories or links, leaf nodes are documents
• keyword search using the VERONICA service

2.5 www/mosaic ("universe of documents")

• information system based on hypertext
• distributed document delivery service using a client-server model
• uses hypertext to make browsing and searching sources of information quick and uncomplicated
• integrates text, graphics and sound as well as links to other resources on its pages
• the user moves from document to document which are linked to each other through marked keywords

3. List of interesting sites for nonlinear research

3.1 Newsgroups

sci.chaos	alt.fractals.pictures
sci.fractals	alt.binaries.pictures.fractals
sci.nonlinear	comp.theory.self-org-sys
alt.fractals	comp.theory.dynamic-sys

3.2 Electronic Conference Lists

AUTOPOIESIS LIST
send a request to subscribe to Kent Palmer: palmer@world.std.com

CHAOPSYC (Society for Chaos in Psychology and the Life Sciences) listproc@moose.uvm.edu
subscribe chaopsyc yourfirstname yourlastname

COMPLEX SYSTEMS OPEN FORUM
listserv@life.anu.edu.au subscribe complex yourfirstname yourlastname

FRAC-L (computergraphical generation of "fractals" and a general dialogue on fractals and chaos)
listserv@gitvm1.bitnet or listserv@gitvm1.gatech.edu
subscribe frac-l yourfirstname yourlastname

NONLIN-L (Economic Nonlinear Dynamics list) listserv@list.nih.gov
subscribe nonlin-l yourfirstname yourlastname

CHAOS NETWORK charges a fee to join , information from chaos@tmn.com

Nonlinear Science Peoprint Bulletin Board
(Los Alamos National Laboratory)
Dynamical systems, chaos, quantum chaos, topological dynamics, cycle expansions, turbulence, propagation: mail to chao-dyn@xyz.lanl.gov
Pattern formation, coherent structures, Solitons : mail to patt-sol@xyz.lanl.gov
Computational methods, time series analysis, signal processing, wavelets, lattice gases: mail to comp-gas@xyz.lanl.gov
Adaptation, interacting particle systems, self-organizing systems, computation theory, machine learning: mail to adap-org@xyz.lanl.gov
For all of the above, send mail to nlin-sys@xyz.lanl.gov

3.3 ftp

lyapunov.ucsd.edu	Non-linear dynamics archive
parcftp.xerox.com	Xerox Palo Alto Research Center (PARC)
xyz.lanl.gov	Archive for papers in nonlinear science
spanky.triumf.ca	Programs, algorithms, papers, pictures
sfi.santafe.edu	/pub/Time-Series Time series archive, analysis and forecasting
life.anu.edu.au	/pub/complex_systems Complex Systems Information Service
ftp.uni-mainz.de	Bibliography
lumpi.informatik.uni-dortmund.de	

3.4 gopher

• life.anu.edu.au
• gopher.santafe.edu

3.5 telnet

telnet askhp.ask.uni-karlsruhe.de
login: ask password: ask

3.6 www

Center for Complex Systems Research:
http://www.ccsr.uiuc.edu/CCSRHome.html
xyz (Preprints from Los Alamos):
http://xyz.lanl.gov/
Complex Systems:
http://life.anu.edu.au/complex_systems/complex.html
Complexity International (Electronic Journal):
http://life.anu.edu.au/ci/ci.html
Complex Systems Together (University of Pennsylvania), very good collection of everything !:
http://www.seas.upenn.edu/ ale/cplxsys.html
Fractal Questions and Answers):
http://www.cis.ohio-state.edu/hypertext/faq/usenet/fractal-faq/faq.html
Fractal Movie Archive:
http://www.cnam.fr/fractals/anim.html
Fractal Videos:
http://www.service.com/stv/
xtoys from Michael Creutz:
http://penguin.phy.bnl.gov/www/xtoys
Fractals by Michael C. Taylor:
http://www.mta.ca/ wwwman/fractals.html
4D-Juliamengen:
http://acacia.ens.fr:8080/home/massimin/quat/quat.ang.html
Gottfried Mayer-Kress:
http://jaguar.ccsr.uiuc.edu/People/gmk/gmk-b.html
Student Chaos Group in Poland:
http://info.fuw.edu.pl/bin/snprg/www

Die Chaosgruppe im World Wide Web

Die Chaosgruppe hat seit kurzem eigene WWW-Seiten im Internet: http://www.nonlin.tu-muenchen.de/chaos/chaos.html

Wer selber eine WWW-Seite hat oder haben möchte, soll sich bei Martin Rast (Martin.Rast@cd1.lrz-muenchen.de) melden.

Studentische Chaosgruppe in Polen

Matthias Sperl fand folgenden Artikel im WWW (http://info.fuw.edu.pl/bin/snprg/www):

Welcome to Student Nonlinear Physics Research Group! at the Faculty of Physics; Warsaw University; Hoza 69; 00-861 Warszawa; POLAND

We are a group of students from various departments of Warsaw University interested in nonlinear models and problems in physics and mathematics. In order to enrich our knowledge in the field we created a Student Nonlinear Physics Research Group at the Faculty of Physics, Warsaw University. The members of the Group are all high motivated and very good students. What joins them is the interest in nonlinearity, but everybody tackles with it a little different: some have more experimental attitude, others try to do some simulations or use computer algebra, while the rest prefer mathematical approach to the matter.

Every Tuesday an invited scientist or one of the members is giving a seminar. There's also a lecture devoted to differential geometry, organized for the members of our Group going on.

During summer we'd like every member to atend a conference or a summer school, or got a summer job at some institute dealing with more or less nonlinear problems - in order to face other problems, meet new people and so on.

We have got in touch with Physics Societies from other universities in Poland e.g. Jagiellonian University in Cracow or Wroclaw University. In next year we would like to extend our activities. We hope our group will be the seed of the Society of Physics Students of Warsaw University and eventually turn into a branch of this bigger organization. The next step would be to lead to unification of physics students movement in Poland, i.e. organizing Polish Soc. of Phys. Stud. and eventually applying for an IAPS membership. This is still a song of future but we'll do it.

If you organize any seminars or summer schools devoted to nonlinear physics or mathematics or have any summer jobs available for students(computer, experimental, theoretical), please let us know.

With greetings

The Board:
Pawel Klimczewski
Piotr Szymczak
Daniel Wojcik - president

Terminkalender

22.08-26.08.1994
DPG-Fortbildungskurs für Physiklehrer Kurs 2: Dynamik fluider Systeme, Bad Honnef, K: I. Rehberg, Univ. Bayreuth, W. Schneider, Univ. Erlangen-Nürnberg

05.09.-07.09.1994
International Conference on Nonlinear Dynamics and Optics, Scuole Normale Superiore Pisa, Italy, K: Fax: ++39/50/563513, arimondo@ipifidpt.difi.umipi.it

05.09-08.09.1994
2. European computational fluid dynamics (CFD) conference, Stuttgart, Germany, K: Deutsche Gesellschaft für Luft- und Raumfahrt e.V., Godesberger Allee 70, D-53175 Bonn

26.09.-28.09.1994
COMPLEX'94, Second Australian National Conference, University of Central Queensland, Rockhampton Queensland, Australia, K:

26.09.-30.09.1994
Interdisciplinary Autumn School on Nonlinear Analysis of Physiological Time Series, Würzburg, K: Dr. M. Meesmann, Medizinische Universtaetsklinik, Josef-Schneider-Str. 2, D-97080 Würzburg, Fax: 0931/201-2291, email: medk271@rzbox.uni-wuerzburg.de

28.09.-30.09.1994
Complexity: Emerging Lessons from Economics, Technology, Education, and Social Systems, Denver, Colorado, K: chaos@tmn.com

01.10.-03.10.1994
International Workshop on Nonlinear Dynamics, Fractality, and Selforganization of Complex Systems, Würzburg, K: Dr. M. Meesmann, Medizinische Universtaetsklinik, Josef-Schneider-Str. 2, D-97080 Würzburg, Fax: 0931/201-2291, email: medk271@rzbox.uniwuerzburg.de

06.10.-07.10.1994
Fachsitzungen der Schweizerischen Physikalischen Gesellschaft, Aarau, Schweiz, K:

07.10.-09.10.1994
Ferienakademie für Studentinnen und junge Wissenschaftlerinnen über komplexe Systeme und nichtlineare Dynamik, Tutzing, Oberbayern, K: Info und Anmeldung: Frau Prof. Dr. Irma Hanke, TU München, 089 / 2105-8339 oder Prof. Dr. Andrea Abele-Brehm, Uni Erlangen, 09131 / 85-2951 oder -2307

13.10.-16.10.1994
Dynamical Systems and Related Topics Workshop, Penn State University, Nittany Lion Inn, Colonial Room, K:

19.11.94
Jahrestagung der Chaosgruppe e.V.: Chaos und Strukturbildung '94: 4. öffentliches, interdisziplinäres Symposium zu Theorie, Anwendung und Didaktik Nichtlinearer Dynamik. Hauptvortrag: H.O.Peitgen (Univ. Bremen), „Fraktale Codierung von Strukturbildungsprozessen“, TU München, K: Chaosgruppe e.V, TU München, D-80290 München, rahammer@cip.physik.tumuenchen.de

13.02-24.02.1995
Chaos - The Interplay Between Stochastics & Quanta, Karpacz Winter School, Karpacz, Wroclaw PL, K: karp95@ift.uni.wroc.pl

07.02-10.02.1995
FRACTAL 95, Fractals in the Natural and Applied Sciences, 3rd International Working Conference, Marseille, France, K:

21.05.-24.05.1995
Third SIAM Conference on Applications of Dynamical Systems, Snowbird, Utah, K: meetings@siam.org

25.06.-29.06.1995
AMS Summer Workshop in Smooth Dynamical Systems and Dimension Theory, Univ. of. Washington, Seattle, K: Yokov Pesin, Penn. State Univ., pesin@math.psu.edu

9.10.-11.10.1995
Motion Control, Lehrstuhl B für Mechanik, TUM, K: Prof. Dr.-Ing. F. Pfeiffer, TUM, D-80290 Muenchen, Germany, Tel:+49 89 2105 3201, Fax: +49 89 2105 3209, ifacmoco@lbm.mw.tu-muenchen.de