Proposal

Submitted to Executive Committee of EURO,
The Association of European Operational Research Societies

for a New
EURO Working Group

"Operational Research in Computational Biology and Bioinformatics",

in short:
"Computational Biology and Bioinformatics"

Gerhard-Wilhelm Weber

Institute of Applied Mathematics, METU, Ankara, and
EURO Working Group on Continuous Optimization (EUROPT)

Abstract

The aims of the proposed new EURO Working Group are (1) *to establish an open forum of exchange, scientific life and collaboration using modern methods of OR within EURO, integrating already existing groups, impulses and individuals from European and international Operational Research in the emerging fields of biological problems and perspectives in data management, analysis and technologies;* (2) *to integrate researchers and practitioners in OR to overcome the scientific challenges in medicine, pharmacy, food production, conservation of genetic wealth, alternative energy generation and of development. Herewith, embedded into and for the best of the scientific landscape and calendar of EURO and its existing working groups and chapters,* (3) *this group looks for giving valuable contributions to building up our countries and their friendship, to welfare, freedom and peace in and among the nations and continents.*

In case of appreciation and approval of this proposal for a new EURO WG "Operational Research in Computational Biology and Bioinformatics", its foundation ceremony is considered for the conference days of EURO XXI 2006 *in Reykjavik, Iceland, July 2-5, 2006.*

1. Introduction

As it is explained in some more detail below, this proposal on a ***EURO WG "Operational Research in Computational Biology and Bioinformatics"***, in short, ***"Operational Research in Computational Biology and Bioinformatics"*** and abbreviated by, e.g., *EWG CBI*, bases on some invitation for merging of two lines of modern biological research cultures and traditions, unified by and in the house of European ***Operational Research***:

    (i)   **"Computational Biology"**,
which encompasses the more mathematics based and aided investigations in biology, with special emphasis on methods of modeling, dynamical systems, networks, continuous optimization, numerical analysis, statistical learning and inverse problems, and

    (ii)   **"Bioinformatics"**,
by which the more computer science and informatics based and aided investigations in biology are understood, with special emphasis on methods for data bases, algorithms or heuristics, complexity, discrete optimization and, in general, various fields of combinatorial and discrete mathematics applied.

By both lines, two of the streams which classically contribute to Operational Research (***OR***) are represented: applied mathematics and computer sciences. Moreover, the central stream of OR coming from *management sciences* and *econony* is one more foundation of this new group in theory, methods and applications. In fact, OR based computational biology and bioinformatics is in a concerted way contributed by so many *disciplines*, namely, by the following list (details will be given later on):

- *biology*,
- *applied mathematics*,
- *computer science* and *informatics*,
- *decision making,*
- chemistry (*biochemistry*),
- technology (*biotechnology* and *material sciences*),
- *medicine*,
- *pharmacy*,
- *food engineering*,
- *energy production* and *management,*
- *history*,
- *management sciences*,
- *economy* and *financial sciences,*
- *environmental sciences,*
- *sustainable development and living* and
- *ethics*.

The variety and wealth of these areas ask for an interdisciplinary approach which **operational research**, our *"Science of Better"*, and its international *research and social network* are prepared to provide best. Even today, by computational biology and bioinformatics being topics at various conferences, summer institutes and workshops under the roof of *EURO* and *IFORS*, this emerging area became part of our OR life. As some further clue and small example on this, the link *Biochemistry PhD Programs* (http://www.amgdb.org/) recently published on our EURO homepage may be mentioned.

What is more, those biology related areas and OR in general are not only providing or serving biology and its modern applications as "computational biology and bioinformatics", what looks already preciously enough. No, by computational biology and bioinformatics modern applied biology is serving a lot to develop better medicine and "better" (more healthy and tasteful) food and to a technical progress which saves lives and resources; it helps to better understand human beings and the history of peoples, showing that we all are very close. The discovery, understanding and protection of rare "gene pools" in flora and fauna will become more and more important for our world, and these heritages get a strong economical meaning also. The same can be said about the use of quantitative methods in genetics for an optimized energy production out of biomass and, very modern nowadays, by photobiological production of hydrogen gas for an energy supply from microorganisms. Furthermore, via computational biology and bioinformatics, modern biology also stimulates and enriches the related areas of applied mathematics, computer science and OR! Indeed, almost every scientist has already heard about genetic algorithms, and new neuro sciences and brain research give a strong positive impact to an understanding of learning. In this way, even a new discipline of applied mathematics became "naturally" created: *statistical learning*, which is nowadays used in many OR applications.

The research and topics of the new group include but are not limited to the following:

- o *Medical Problems and Their Mathematical Modeling,*
- o *Modeling, Dynamics and Predicition of Gene Patterns,*
- o *Structure and Dynamics of Gene Networks,*
- o *Phylogenetic Trees and Classification,*
- o *Pathway Engineering,*
- o *Population Genetics and Statistical Genetics,*
- o *Gene Dynamics,*
- o *Protection of Species and Populations (Gene Pools),*
- o *Statistical Design and Learning in Microarray Experiments,*
- o *Biomolecular Sequence Analysis,*
- o *Comparative Genomics,*
- o *Biomedical Genome Research,*
- o *Proteome Research,*
- o *Protein Expression and Modifications,*
- o *Protein Structure Prediction,*
- o *Protein Interaction and Prediction Peptide Structure,*
- o *Modeling, Dynamics and Predicition of Metabolic Reactions,*
- o *Metabolic Networks,*
- o *Systems Biology,*
- o *Computerized Tomography,*
- o *Discrete Tomography,*

- *Trees in Medical Image Processing,*
- *Structure Building Processes in Biology,*
- *Pharmaceutical Applications,*
- *Cancer Research,*
- *Brain Research,*
- *Heart Research,*
- *Computational Sports Medicine,*
- *Medicine in Recovering and Rehabilitation Processes,*
- *Environmental Effects on Health,*
- *Biological Aspects of Sustainable Living on Rural Countrysides,*
- *Biotechnology in Energy Production*   and
- *Networks in Life Sciences and Society.*

At the very beginning of this impulse and submission of a new *EURO WG "Computational Biology and Bioinformatics"* to EURO was the foundation of **"Computational Biology and Medicine" Group** (http://www.iam.metu.edu.tr/research/groups/compbio/index.html) with its investigations and its weekly seminars. This is a research group hosted by *Institute of Applied Mathematics* (*IAM*) of METU, Ankara (http://www.iam.metu.edu.tr/), together with *YUUP Biyotip Working Group "Bioinformatics" of METU* (for entire YUUP Biyotip cf. http://www.yuup.metu.edu.tr/biyotip/listeuye.htm) and, since eight months, with EURO WG EUROPT. That **Computational Biology and Medicine Group** has members and friends from Turkey and all over the world; its associated e-mail list increases. At a number of scientific events and by personal contact, further colleagues learned about this initiative of a new EURO working group and became supportive for it.

In fact, some interested groups and individuals are close to us already (cf. Section 4); further ones are cordially invited and welcome to become our partners and friends, to join our impulse within *EURO*. In the present phase and in the next steps, *EURO Working Group on Continuous Optimization* (*EUROPT*; http://www.iam.metu.edu.tr/EUROPT/) is offering some starting help and organizational "sponsorship". This kind of foundation help of new EURO working groups is one of the commitments of EUROPT.

Special emphasis is paid by us to a close relationship with the other already existing EURO working groups. Let us please mention one of them: *EURO Working Group "OR Applied to Health Services"* (*ORAHS*; http://www.orahsweb.soton.ac.uk/). This group is by some common interests in medicine and pharmacy related, but it differs by its special attention to *economics, management sciences* and *decision making*. Our proposed new EURO working group is closer to *biology* and *bio-*sciences at all, as its name already indicates, but fully on the basis of operational research and its methods. Herewith, both European groups would become *complementary*. By first personal friendship and collaboration at the occasion of common EURO scientific events such as *EURO XXI 2006* in Iceland (http://www.euro2006.org/) where there is also a Stream *"OR in Health Care"*, and (if you allow, and since you indicated some appreciation from your EURO's side to me) *ESI 2006* in Germany (http://wwwopt.mathematik.tu-darmstadt.de/events/esi2006/), this ORAHS-EUROPT joint utilization of synergy effects and friendship is already in first preparation. In particular, there is a special common challenge which both groups share and can work on together: **health informatics**! Both can go here hand and hand. As a small model that a combination of both bio- and health informatics is possible, please have a look at the link of *International Symposium on Health Informatics and Bioinformatics* (*HIBIT*;

http://hibit05.ii.metu.edu.tr/index.html), Antalya, Turkey, November 10-12, 2005. Aim of this symposium has been to make a head start for researchers who work or want to work in these very popular and fulfilling areas, and it brought together medical, biological and IT sectors for creating a very much needed synergy. We shall come back to this later on.

Many valuable and encouraging responses from various parts of the world have given quite a positive feedback to our enthusiasm, motivations and plan for this new EURO working group in OR.

In autumn 2004, the organizers (PC/OC) of the conference **EURO XXI 2006**, Reykjavik, Iceland, July 2-5 (http://www.euro2006.org/), invited two of us to organize a ***Stream*** (4 or more sessions) on our topic *"Computational Biology and Biology"*; these Stream Organizers are: *Jacek Blazewicz* (Poznan, Poland) and *Metin Türkay* (Istanbul, Turkey). Both colleagues have already demonstrated their closeness and commitment to EURO, e.g., by their engagement at previous EURO conferences and in EUROPT. It is a great honour for them to serve for EURO XXI 2006 with this particular responsibility. They are supporting this proposal for a new EURO working group together with *Guiseppe Lancia* (Udine, Italy), *Bjarni V. Halldorsson* (Reykjavik, Iceland) and *G.-W. Weber*, all of them being also Session Organizers in that stream. Finally, *Stefan Wolfgang Pickl* (Munich, Germany) is with us in the core team of our initiative; he is the coordinator of *Working Group "Optimization of Biosystems"* of *German Operations Research Society* (*GOR*; http://www.gor-ev.de/), Stream Organizer of the stream *"Systems and Game Theory"* and a semi-plenary speaker at EURO XXI 2006.

2. Idea

Since ten years, the development of *computational biology and bioinformatics* tends more and more from a descriptive to an analytic science: Analytic tools are needed which allow a deep understanding of biological data and biochemical processes. Within those tools, methods of *operations research* are applied. Surely, they are adapted to these specific situations. Within these adaptive procedures, *optimization* techniques are exploited in order to get qualitative results.

A first working step in computational biology and bioinformatics consists of the analysis of static data – the identifying of clusters which represents certain biological properties. This effort was supported by alignment techniques. In comparison to that, at the moment, whole gene regulation processes are examined: The static data of different time-steps have to be used to understand and model a dynamical process. The first phase of a metabolic process is gained by such an approach. It is very difficult to describe (simulate) such a process. For that reason, a parallel sensitivity analysis which is also using further *operations research* techniques is integrated.

Dynamical systems are characterized by certain invariants. Although there is an uncertainty within the biological data, parametrical regions of stability and instability should be determined. New algorithmic procedures are developed. These techniques are embedded into *comfortable software tools* which might be integrated into an environment that can be used within a biological lab. These software solutions (for example, *TIGR*) guarantee a detailed analysis.

Classical operational research techniques helped to understand and to optimize industrial processes. This bijective behaviour is one property of operations research: It is a tool and technique. Adapted optimization techniques help to understand certain behaviour. By the same way, operational research methods help to understand biological processess. Additionally, they help to develop analytic tools (which help to understand such biological processes).

At the moment, there is a lack of such analytic tools. Operational research in the context of computational biology and bioinformatics is not restricted to optimization techniques but to the *simulation* of certain biological behaviour: many aspects come into play. Genetic programming will be used in the near future to characterize certain (evolutionary) strategies, advanced Markov process are adapted to certain dynamical and partially hidden situations, and dynamic programming techniques are applied to certain biological scenarios.

EURO working group EUROPT has focussed its attention, among other topics, to that special field of interest. In fact, here it contributed by EUROPT workshops, namely, *"Advances in Continuous Optimization"*, Istanbul, Turkey, July 4-5, 2003 (http://www.iam.metu.edu.tr/contopt03/conf/index.html), *"Challenges of Continuous Optimization in Theory and Applications"*, Rhodes, Greece, July 2-3, 2004 (http://www.iam.metu.edu.tr/contopt04/index.html) and forthcoming ones (e.g., http://wwwhome.math.utwente.nl/~stillgj/COPT06/), sessions organized by EUROPT at EURO conferences, e.g., *EURO XX Conference*, Rhodes, Greece, July 4-7, 2004 (http://www.euro-rhodes2004.org/), the forthcoming conference *EURO XXI 2006* on Iceland (http://www.euro2006.org/) with our stream and, finally, also *EURO Summer Institute "Optimization and Data Mining"*, Ankara, Turkey, July 9-25, 2004 (http://www.iam.metu.edu.tr/esi04/index.html). Recently, there has been one more forthcoming scientific event, supported by EUROPT, which served for advertising and establishing of the possible new EURO working group and for EURO at all: *International Symposium on Health Informatics and Bioinformatics, Turkey '05, HIBIT*, Antalya, Turkey, November 10-12, 2005 (http://hibit05.ii.metu.edu.tr/index.html). Both of these events were organized by members of our group. Before the considered foundation of our working group on Iceland, there will also be *"Workshop on Geometric Morphometrics"*, Ankara, June 12-16, 2006 (http://www.iam.metu.edu.tr/cek/index.htm) prepared by group members, and we organize*"Workshop on Networks in Computational Biology"*, Ankara, September 10-12, 2006 (http://www.iam.metu.edu.tr/Networks_in_Computational_Biology/). Further events planned will be mentioned later on.

These contributions reflect and underline that important development in the field of computational biology and bioinformatics which is (also) an important field of *operations research*! In short, the central objective to our proposed new EURO working group can be stated as follows:

*The objective of EURO Working Group "Operational Research in Computational Biology and Bioinformatics" is to make a re-effort in the integration of people from mathematics, computer science, engineering, medicine, pharmacy, management, economy and social sciences with the ideas of presenting the state and offers of modern **Operational Research**, especially, to the practitioners and teachers, in using these offers of knowledge, scientific and practical experience, of communication and collaboration, to make new research and*

applications for serving people and overcoming scientific, health and economical challenges while respecting ethical aspects via the local integration of EURO.

This integration has an OR impact not only to the academic world but to the local companies of any kind of service or manufacturing, e.g., in medicine, drug design, agriculture, energy production or food industry, and corresponding information and communication technologies of the future as well. Thus, people with knowledge and experience in OR techniques and solutions (cf. http://www.informs.org/Resources/) will be invited to work and exchange their expertise in OR with young people from the European countries and worldwide.

Among the classical and new fields of methods of OR which our proposed new EURO Working Group *Operational Research in Computational Biology and Bioinformatics* would like to learn from, to use and collaborate with its representatives, there are:

- *combinatorial and discrete optimization,*
- *continuous optimization,*
- *mixed-integer programming,*
- *graphs and networks,*
- *network optimization,*
- *algorithms, heuristics and complexity,*
- *problem structuring methods, soft OR,*
- *multicriteria analysis,*
- *decision theory,*
- *data mining and statistical learning,*
- *management sciences and economics,*
- *health care and health services,*
- *complex societal problems,*
- *OR for sustainable development,*
- *energy planning and management,*
- *environmental management,*
- *agriculture and forest management,*   and
- *ethics and OR.*

In this proposal, a number of these intended utilizations are closer explained. By given connections in methodologies, there are even more classical OR domains related, e.g., *transportation*, *locational analysis* and *experimental economics*.

Wherever the foundation of *centers of excellence* is helpful, we will try to encourage this. Besides of the classical understanding of these centers in its academical, towards the top and future oriented terms, we underline an understanding in *cordial* terms of loving the individual person and of a will the learn from the wealth of knowledge locally collected and gained.

We emphasize that central role of *education* in the entire process of collaboration. Here, we are learners also and invite to a *common learning* and *scientific progress*: *feedback from applications to theory, and from practitioners and young people to centers of excellence.*

For all this, our group wants to apply for and regularly use the precious scientifical instruments and offers of EURO, namely, in particular:

- ❖ EURO working group's ***Workshops***,

- ❖ ***Sessions at EURO conferences*** organized by the EURO working group,

- ❖ ***EURO Summer and Winter Institutes***,

- ❖ ***EURO Mini Conferences***, and

- ❖ ***Special Issues*** of ***European Journal of Operational Research*** (EJOR).

As a first official activity of our new EURO working group, there could be the ***Stream "Computational Biology and Bioinformatics"*** at ***EURO XXI 2006***, Reykjavik, Iceland, July 2-5, 2006, guided by a small foundation celebration. The Stream Organizers are *Jacek Blazewicz* and *Metin Türkay*. Moreover, we are in discussion with you – the leaders of EURO – about a ***EURO Mini Conference "Operational Research for Development"*** (subtitles: ***Optimization of Biosystems – Improvement of Living Conditions***). This EURO MC is proposed for *September 2007* in *South Africa*, (co-) organized by EUROPT as a helping EURO working group, together with the already approved new *EURO Working Group "Operational Research for Development"* and the possible new one *"Operational Research in Computational Biology and Bioinformatics"*. As organizers, many valuable colleagues from the related fields of operational research expressed their willing to support and contribute. Among other experts gathered in the organizing committee and the programm committee, the following colleagues could serve as Chair and Co-Chairs: *Montaz Ali* (Witwatersrand, South Africa) and *T. Marwala* (Witwatersrand, South Africa), *Jacek Blazewicz* (Poznan, Poland), *Eric Soubeiga* (Nottingham, UK), *Theo Stewart* (Cape Town, South Africa), *Gerhard-Wilhelm Webe*r and *Leroy White* (Bristol, UK), together with further ones prepared for becoming leaders and coordinators of the two considered new EURO working groups.

3. Challenges and Applications

The increasing information and data stored in databases enforce the scientists and researchers to use computerized techniques in order to understand the mechanism of biological systems hidden inside these data. Experimental methods developed for analyzing the behaviour of the system or feature of the genome sequence can be extremely expensive for a large number of trials. However, *statistical methods* and *computational algorithms* can enable us to understand the main structure of the system behaviours from priori information gathered from experiments. *Mathematical* models are constructed to generalize the mechanism of the empirical observations and *computerized machine learning algorithms* are developed to achieve faster convergence to the solution. The collaborated studies in the computational, algorithmic, mathematical and biological area define the term called ***computational biology and bioinformatics***. In this sense, one cannot study alone without any support from another disciplines to solve real world problems. Thus, biologists cannot predict the future behaviour of the biological system without any mathematical model and engineering techniques by means of a computer, and mathematicians or engineers cannot

construct a model and algorithm without knowing the fundamental features related with the physical problem and without having experimental data.

Once having constructed a mathematical method, the robustness of a model must be controlled by the means of *statistical methods*. Many statistical methods are developed for testing hypothesis whether they control the accuracy of our solution and the model. In order to test our hypothesis coming from the model or statistical data, enough data associated with the problem are needed. A new modern approach for modelling and predicting a genetical process and, then, testing the model (goodness of fitting test), consists in parametrical differential equations and in looking at their stability behaviour. Of course, the right interpretation of the mathematical or simulation results can only be given in close discussion with the colleagues from biology.

Since the real world problems include nonlinear complex systems, smart mathematical techniques must be developed and improved to overcome a large number of system parameters. Together with the request for high accuracy, this complexity concern is a main goal in the modern theory of inverse problems. In this sense, exploiting *sparsity* structures and, in particular, *optimization methods* come into play in order to find the best parameter constellation for the model system. Not all parameters can be measured during the experiments or measurement series. One must find the best parameters fitting to our model with a small error tolerance. Furthermore, not only the number of parameters has to be kept small: also on the number of experiments there are economical and ethical constraints imposed.

For all these reasons, OR based *computational biology and bioinformatics* is established on an integrated view and concerted utilization of interdisciplinary areas from *natural and engineering sciences*, *mathematics* and *computer science*, *management* and *social sciences*.

In the scope of our interest, there are problems ranging from genetics, over metabolic engineering including, e.g., the optimization of training programs in sports medicine or for patients in recovering, to the inverse problems of brain and heart research. The following (incomplete) list consists of fields of modern challenges:

    I.   *biomolecular sequence analysis*,
    II.   *comparative genomics*,
    III.   modelling and prediction of *gene patterns*,
    IV.   *biomedical genome research*,
    V.   *microarray informatics*,
    VI.   *biomedical proteome research*,
    VII.   *protein structure* prediction,
    VIII.   *protein interactions*,
    IX.   *genetic networks*,
    X.   *systems biology*,
    XI.   *population dynamics*,
    XII.   *gene dynamics*,
    XIII.   *gene classification* (e.g., for protection of gene pools),
    XIV.   *geometric morphometry*,
    XV.   *protein expression* and *modifications*,
    XVI.   *drug design*,

XVII.   *computational metabolism*,
XVIII.   optimization of *training programs*,
 XIX.   *experimental design in biology*,
  XX.   *biomaterials* and *bioenergy*,
 XXI.   *renewable resources*,
XXII.   *brain tomography*,
XXIII.   *heart research*,
XXIV.   *electronic health records* and *standards*,
 XXV.   *clinical informatics* and *hospital information systems*,
XXVI.   *telemedicine* and *mobile applications*,
XXVII.   *decision support systems* and *computer aided diagnosis*,
XXVIII.   *health informatics* (*HI*) *education*,
XXIX.   *security, ethics* and *privacy*,
 XXX.   *data mining* and *knowledge discovery* in HI,
XXXI.   *medical signal/image analysis* and *visualization*,
XXXII.   *medical imaging* and *instrumentation*   and
XXXIII.   *virtual reality* and simulation.

All these challenges and efforts will hopefully establish and maintain a new dynamical network in Europe and the world, hosted by EURO, widening the scope and range of scientific interests, friends and members of EURO and its working groups to the progressive and emerging fields of applied biology which, reversely, will be fruitful for the methodology of future operational research. Our proposed new EURO Working Group *Operational Research in Computational Biology and Bioinformatics* wishes to contribute to promoting and creating *awareness* about OR to the young researchers of various backgrounds. These offers take place in full accordance, harmony and collaboration with the efforts of international OR, especially, of EURO and IFORS.

4.   A First List of Interested Colleagues and Groups

Colleagues and friends who are carrying our initiative and possibly could be among the founding members of **EURO Working Group "Operational Research in Computational Biology and Bioinformatics"** (in short: *"Computational Biology and Bioinformatics"*, abbreviated by *EWG CBI*, or differently called, just as you and we may wish) are, in particular:

- *Marat U. Akhmet* (METU, IAM and Department of Mathematics, Ankara, Turkey; "Computational Biology and Medicine" Group, IAM and YUUP; EUROPT; marat@metu.edu.tr)
- *Tural Aksel*   (Sabanci University, Faculty of Engineering and Natural Sciences, Istanbul, Turkey; tural@su.sabanciuniv.edu)
- *Badr Al-Daihani* (University of Cardiff, School of Computer Science, School of Biosciences, Cardiff, UK; badr@cs.cf.ac.uk)

- *Montaz Ali* (University of Witwatersrand, School of Computational and Applied Mathematics, Johannesburg, South Africa; EUROPT; mali@cam.wits.ac.za)
- *Ayhan Altun* (METU, Department of Biology, Ankara, Turkey; aaltun@metu.edu.tr)
- *Volkan Atalay* (METU, Department of Computer Engineering, Ankara, Turkey; "Computational Biology and Medicine" Group, IAM and YUUP; volkan@ceng.metu.edu.tr)
- *Jose Augusto Amgarten Quitzau* (University of Campinas, Laboratory for Bioinformatics, Brazil; "Computational Biology and Medicine" Group, IAM and YUUP; quitzau@gmail.com)
- *Ahmet Arman* (Marmara University, Faculty of Engineering, Environmental Engineering, Istanbul, Turkey; aarman@eng.marmara.edu.tr)
- *Volkan Atalay* (METU, Department of Computer Engineering, Ankara, Turkey; volkan@ceng.metu.edu.tr)
- *Gleb Beliakov* (Deakin University, School of Information Technology, School of Biological and Chemical Sciences, Burwood, Vic., Australia; EUROPT; gleb@deakin.edu.au)
- *Ceren Berkman* (METU, Department of Biology, Ankara, Turkey; "Computational Biology and Medicine" Group, IAM and YUUP; cerenberkman@yahoo.com)
- *Biter Bilen* (Bilkent University, Department of Molecular Biology and Genetics, Ankara, Turkey; "Computational Biology and Medicine" Group, IAM and YUUP; biter@bilkent.edu.tr)
- *Jacek Blazewicz* (Poznan University of Technology, Institute of Computing Science, and Polish Academy of Sciences, Institute of Bioorganic Chemistry, Poznan, Poland; EURO Gold Medal, 1991; EUROPT; Jacek.Blazewicz@cs.put.poznan.pl)
- *Tolga Can* (METU, Department of Computer Engineering, Ankara, Turkey; "Computational Biology and Medicine" Group, IAM and YUUP; EUROPT; tcan@ceng.metu.edu.tr)
- *Jerry Chandler* (George Mason University, Krasnow Institute for Advanced Study, Fairfax, USA; Jerry.LR.Chandler@Cox.net, Jerry_LR_Chandler@Mac.com)
- *M. Ulas Cinar* (University of the Aegean, Faculty of Agriculture, Izmir, Turkey; ulas.cinar@ege.edu.tr)
- *Philippe de Backer* (Ghent University, Department of Molecular Genetics, Belgium; EUROPT; phback@psb.UGent.be, [Philippe.DeBacker@UGent.be)](mailto:Philippe.DeBacker@UGent.be)
- *Ewa Dogru* (METU, Department of Biology, Ankara, Turkey; bioewa@metu.edu.tr)
- *T. Selim Eskiizmirliler* (Université Pierre et Marie Curie – Paris 6, INSERM U-742, ANİM, Paris, France;

selim@ccr.jussieu.fr)

- o *Jon Garibaldi* (University of Nottingham, School of Computer Science and IT; Nottingham, United Kingdom; jmg@cs.nott.ac.uk)
- o *Cigdem Gökcek* (METU, Department of Biology, Ankara, Turkey; EUROPT; cerenberkman@yahoo.com)
- o *Arturo Graziano Grappone* (medical doctor, II University of Rome, Italy; a.grappone@mclink.it)
- o *Bjarni V. Halldorsson* (deCode, Reykjavik, Iceland; bjarni.halldorsson@decode.is)
- o *Scott Hazelhurst* (University of Witwatersrand, School of Computer Science, Johannesburg, South Africa; scott@cs.wits.ac.za)
- o *Uwe Kaempf* (Dresden University of Technology, Department of Physics, Germany; EUROPT; uwe.kaempf@psychologie.tu-dresden.de)
- o *Bülent Karasözen* (METU, IAM and Department of Mathematics, Ankara, Turkey; "Computational Biology and Medicine" Group, IAM and YUUP; EUROPT; bulent@metu.edu.tr)
- o *Aykut Kence* (METU, Department of Biology, Ankara, Turkey; aykut@metu.edu.tr)
- o *Meral Kence* (METU, Department of Biology, Ankara, Turkey; mkence@metu.edu.tr)
- o *Miroljub Kljajic* (University of Maribor, Laboratory of Cybernetics and Decision Support Systems, Slovenia; miroljub.kljajic@fov.uni-mb.si)
- o *Attila Kuba* (Department of Image Processing and Computer Graphics, University of Szeged, Hungary; EUROPT; kuba@inf.u-szeged.hu)
- o *Natalio Krasnogor* (University of Nottingham, School of Computer Science and IT; Nottingham, United Kingdom; Natalio.Krasnogor@nottingham.ac.uk)
- • *Guiseppe Lancia* (University of Udine, Department of Mathematics and Computer Science, Italy; lancia@dimi.uniud.it)
- o *Vladimir F. Levchenko* (Institute of Evolutionary Physiology and Biochemistry of Russian Acad. Sci., St. Petersburg, Russia; lew@iephb.nw.ru)
- o *Alexander Makarenko* (National Technical University, Institute of Applied System Analysis, Kiev, Ukraine; EUROPT; makalex@mmsa.ntu-kpi.kiev.ua)
- o *Ü. Erkan Mumcuoglu* (METU, Informatics Institute and IAM, Ankara, Turkey; "Computational Biology and Medicine" Group, IAM and YUUP; mumcuoglu@ii.metu.edu.tr)
- o *Zümrüt B. Ögel* (METU, Department of Food Engineering and IAM, Ankara, Turkey; "Computational Biology and Medicine" Group, IAM and YUUP;

zogel@metu.edu.tr)

- o *Hakan Öktem* (METU, IAM and Department of Mathematics, Ankara, Turkey; "Computational Biology and Medicine" Group, IAM and YUUP; EUROPT; marat@metu.edu.tr)

- o *Gülay Özcengiz* (METU, Department of Biology, Ankara, Turkey; ozcengiz@metu.edu.tr)

- o *Süreyya Özögür* (METU, IAM, Ankara, Turkey; "Computational Biology and Medicine" Group, IAM and YUUP; EUROPT; sozogur@metu.edu.tr)

- o *Ahmet Rasit Öztürk* (Bilkent University, Department of Molecular Biology and Medicine, Ankara, Turkey; rasit@ug.bilkent.edu.tr)

- o *Deniz Özüt* (METU, Department of Biology, Ankara, Turkey; ozut@metu.edu.tr)

- • *Stefan Wolfgang Pickl* (University of German Army, Faculty of Informatics, Munich, Germany; "Computational Biology and Medicine" Group, IAM and YUUP; coordinator of GOR Working Group "Optimization of Biosystems"; EUROPT; spickl@informatik.unibw-muenchen.de)

- o *Emily Quek* (Malaysian Palm Oil Board, Selangor, Malaysia; "Computational Biology and Medicine" Group, IAM and YUUP; EUROPT; emilyq@rocketmail.com)

- o *Salvatore Santoli* (International Nanobiological Testbed Ltd. – INT, Rome, Italy; intitsnt@uni.net)

- o *Mihaela Sbarciog* (Ghent University, Department of Electrical Energy, Systems and Automation, Belgium; mihaela@autoctrl.ugent.be)

- o *Andrea Schulte-Thomas* (University of Paderborn, Department of Control Engineering, Paderborn, Germany; "Computational Biology and Medicine Group", IAM and YUUP; A.Schulte-Thomas@control.upb.de)

- o *Alper Söyler* (METU, Department of Food Engineering, Ankara, Turkey; "Computational Biology and Medicine Group", IAM and YUUP; soyler@metu.edu.tr)

- o *Nikolaus von Stillfried* (University of Freiburg; Social Sciences and Interdisciplinary Research; n.stillfried@web.de)

- o *Tomohiro Shirakawa* (Kobe University, Division of Earth & Planetary Science; Graduate School of Natural Science, Kobe, Japan; 026d857n@y04.kobe-u.ac.jp)

- o *Mesut Tastan* (METU, IAM, Ankara, Turkey; "Computational Biology and Medicine" Group, IAM and YUUP; EUROPT; mesudtastan@yahoo.com)

- o *Inci Togan* (METU, IAM and Department of Biology, Ankara, Turkey;

          "Computational Biology and Medicine" Group, IAM and YUUP;
          togan@metu.edu.tr)

o *Berna Torun* (Delft University of Technology, EEMCS, Delft, The Netherlands; EUROPT;
B.Torun@student.tudelft.nl)

- *Metin Türkay* (Koc University, College of Engineering, Istanbul, Turkey; "Computational Biology and Medicine" Group, IAM and YUUP; EUROPT;
mturkay@ku.edu.tr)

o *Joris van Poucke* (Ghent University, Department of Philosophy and Moral Sciences, Belgium; EUROPT ;
joris.vanpoucke@UGent.be)

o *Gerhard-Wilhelm Weber* (METU, IAM and Department of Mathematics, Ankara, Turkey; coordinator of "Computational Biology and Medicine Group" of IAM / YUUP; speaker of YUUP Biyotip Working Group "Bioinformatics" of METU; Vice-Coordinator of EUROPT;
gweber@metu.edu.tr)

o *Shoshana J. Wodak* (Hospital of Sick Children, and University of Toronto, Departments of Biochemistry & Medical Genetics and Microbiology, Toronto, Canada;
shoshana@sickkids.ca)

o *Röbbe Wünschiers* (University of Cologne, Institute of Genetics, Cologne University Bioinformatics Center, Germany; "Computational Biology and Medicine" Group, IAM and YUUP; EUROPT;
robbe.wunschiers@uni-koeln.de)

o *Martin Zachariasen* (University of Copenhagen, Department of Computer Science, DIKU;
martinz@diku.dk)

A few names of *possible coordinators* have been indicated by a **full** circle (not to be understood exclusively, please).

It may be underlined that this list became extended and by many colleagues from different countries enriched in the previous months. Further colleagues and friends joining are sincerely invited and appreciated! On the basis of mutual respect and friendship, they may come from but are not limited to the following working groups, organizations and events:

- *"Computational Biology and Medicine" Group*
(http://www.iam.metu.edu.tr/research/groups/compbio/index.html) ,

    being a research group of Institute of Applied Mathematics (IAM), METU, Ankara, Turkey (http://www.iam.metu.edu.tr/),

    together with

- *YUUP Biyotip Working Group "Bioinformatics" of METU*

(for entire YUUP Biyotip cf. http://www.yuup.metu.edu.tr/biyotip/listeuye.htm)

- *Department of Biology*, *METU*, Ankara, Turkey
  (http://www.bio.metu.edu.tr/)

- *Inserm* (*Institut National de la Santé et de la Recherche Médicale*), *ANIM* (*Action Neuoimaging Modeling*), *Université Pierre et Marie Curie*, Paris, France

- *CAS - MPG* (Max-Planck Gesellschaft) *Partner Institute on Computational Biology*, Shanghai, China
  (http://www.ebast.net.cn/ebast/kxpj/46166.shtml)

- *Cologne University Bioinformatics Center* (*CUBIC*), Cologne, Germany
  (http://www.cubic.uni-koeln.de/)

- *Gülhane Askeri Tip Akademisi* (*GATA*); Hospital and Medical Academy of Turkish Army   (http://www.gata.edu.tr/)

- *International Max Planck Research School for Computational Biology and Scientific Computing* (*IMPRS-CBSC*), Berlin, Germany
  (http://www.imprs-cbsc.mpg.de)

- *International Society for Computational Biology*   (*ISCB*)
  (http://www.iscb.org/)

- *Max-Planck Institute for Mathematics in the Sciences*, Leipzig, Germany
  (http://www.mis.mpg.de/)

- *EURO Working Group on Continuous Optimization*   (*EUROPT*)
  (http://www.iam.metu.edu.tr/EUROPT/)

- *EURO Working Group "OR Applied to Health Servises"* (*ORAHS*)
  (http://www.orahsweb.soton.ac.uk/)

- every other EURO working group
  (http://www.euro-online.org/display.php?page=working_groups&)

  e.g., *EURO WG "OR in Agriculture and Forest Management"*, *EURO Working Group on Ethics and OR*, *EURO WG "European Chapter on Combinatorial Optimization"* (*ECCO*) and *European Network Optimization Group* (*ENOG*).

Of course, those possible or forthcoming members of our proposed EURO working group *Operational Research in Computational Biology and Bioinformatics* will also be motivated and invited to stay close to EURO and its other working groups – why not joining one of them.

5. Conclusion

In academical world not only, but in media and wider public life, *computational biology and bioinformatics* is associated with progress, dynamics, growth, but also with deep discussion in entire societies. Since some years, scientists from European and international operational research are more and more entering this interdisciplinary field, they experience how welcome and fruitful their OR methods are and, at the same time, problems, ways of thinking and asking from biology stimulate and enrich their own traditional home in OR. The challenges and applications of such a new engagement of OR are very wealthy: better understanding of diseases of heart or brain, new medicine, better recovering, new materials and energy, … the beauty of life! Especially, young people feel very much attracted to find a new home in computational biology and bioinformatics and, what is more, in scientific organizations encouraging, sponsoring and hosting this intellectual and social enterprise. The idea of integrating both young and experienced people from Europe and all over the world with the consent of EURO is a new project and also an effort to create and promote awareness and proficiency and a network in OR. This project definitely involves people with more OR knowledge and experience to exchange and contribute their expertise to the young, less experienced researchers and to many given and coming practitioners for the promotion and contribution of OR. This is compatible and mutually supporting with EURO's possible further efforts to dedicate a website on *"OR inside"* to the young or unaware audience, and it may enrich EURO and its modern profile as being discussed and presented in EURO's initiative *Branding OR* (http://www.euro-online.org/display.php?page=branding_or).

Finally, what is more, EURO Working Group *Operational Research in Computational Biology and Bioinformatics* might be a young driving force and by its work hopefully inspire further practical and academical "spin-offs", last but not least in EURO of the future.

We cordially invite you to give us acceptance and approval, to join us if you have got interest, to share our collaboration, vision and friendship! During the days of EURO XXI 2006 in Iceland we could then have a solemn and encouraging founding celebration together with the corresponding stream participants and many friends coming to Reykjavik.

With friendly regards,
cordially yours,

Gerhard-Wilhelm Weber
(*Willi*)
gweber@metu.edu.tr

Ankara, Turkey,   January 15, 2006