



Nature-inspired Smart Information Systems

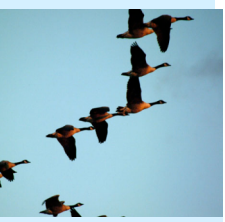
NiSIS

# NiSIS

## Nature-inspired Smart Information Sys

A Co-ordination Action (CA) under FP6 IST FET

16.01.2007 – Neuro-iT.net Workshop



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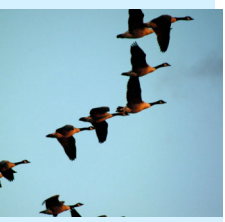
# Setting the Scene

- ERUDIT      Fuzzy Reasoning (NoE 94-00)
- EUNITE      Intelligent Technologies (NoE 01-04)
- NiSIS        Learning from Nature (CA 04-07)



# Overall Mission Aims

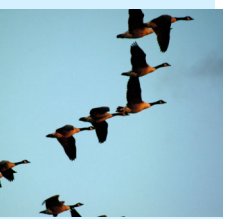
To co-ordinate multi-disciplinary studies and research endeavours into the development and utilisation of intelligent paradigms (bio, social,...) in advanced information systems design.



# Main Objectives

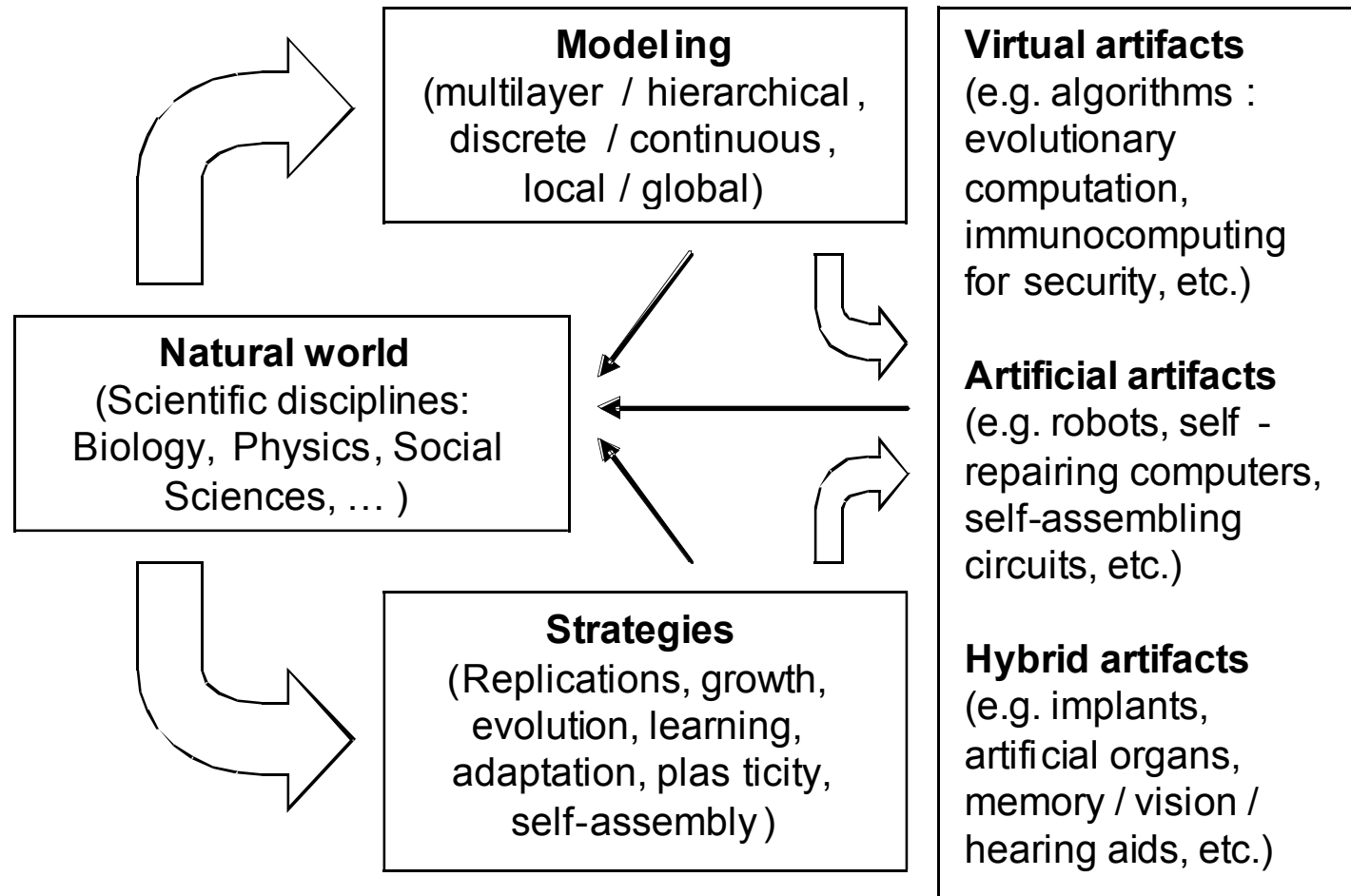
- Progress adaptive systems beyond curiosity
- Improve robustness via modularity, hierarchy etc.
- Embed systems dynamics understanding into intelligent structures
- Encourage cross-disciplinary team-based thinking
- Develop a Strategic Roadmap
- Provide Training, Education and Technology Transfer
- Encourage young researchers
- Cross-link to other relevant groups



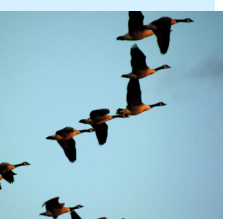


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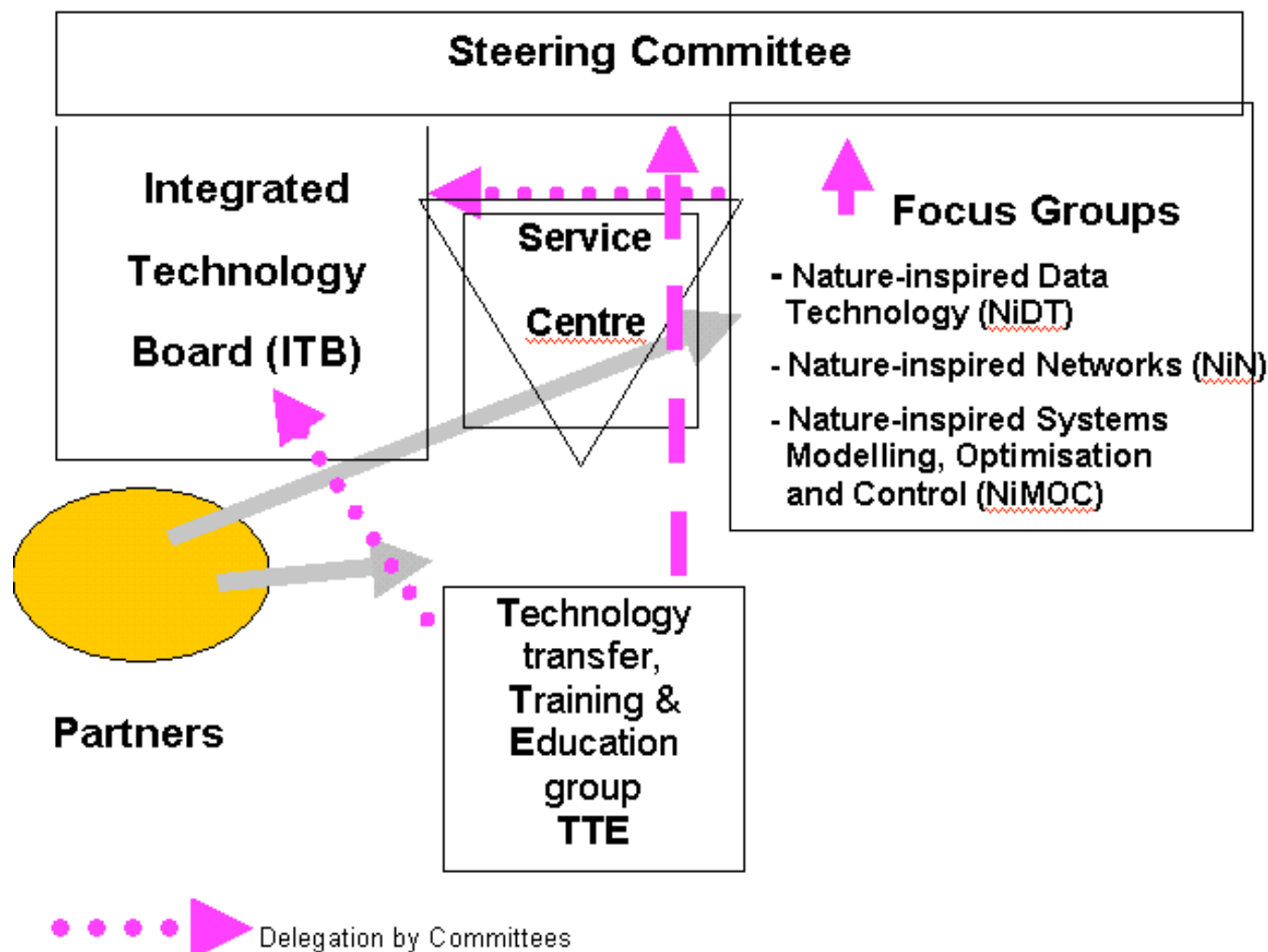
# Inspiration from Nature

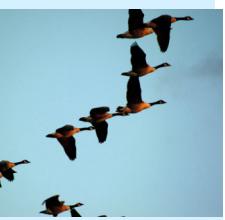


BTH – NiSIS Cooperation



# Components in the Management Structure





# Focus Groups

NiDT  
Nature-inspired  
Data Technology

Chair: Davide Anguita  
University of Genoa  
Italy

[Davide.Anguita@unige.it](mailto:Davide.Anguita@unige.it)

NiN  
Nature-inspired  
Networks

Chair: Trevor Martin  
University of Bristol  
UK

[Trevor.Martin@bristol.ac.uk](mailto:Trevor.Martin@bristol.ac.uk)

NiMOO  
Nature-ins  
Modelling  
Optimization &

Chair: Reinhard G  
Hans-Knoell Inst  
Germany

[Reinhard.Guthke@hkn.de](mailto:Reinhard.Guthke@hkn.de)

ITB  
Integration Technology Board

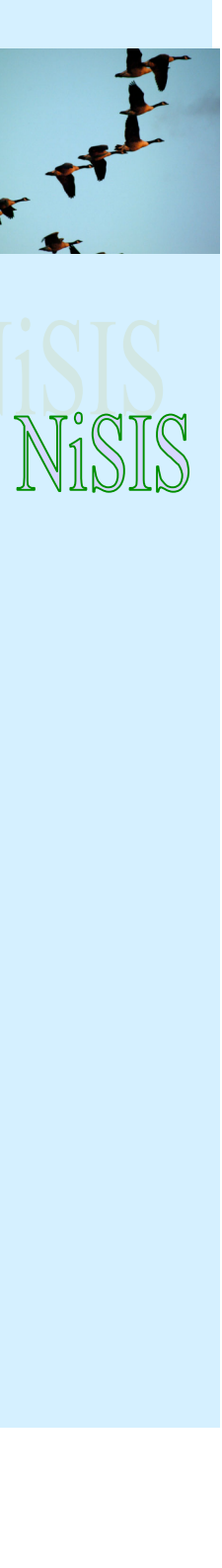
Chair: Derek A. Linkens  
University of Sheffield  
UK

[D.Linkens@sheffield.ac.uk](mailto:D.Linkens@sheffield.ac.uk)



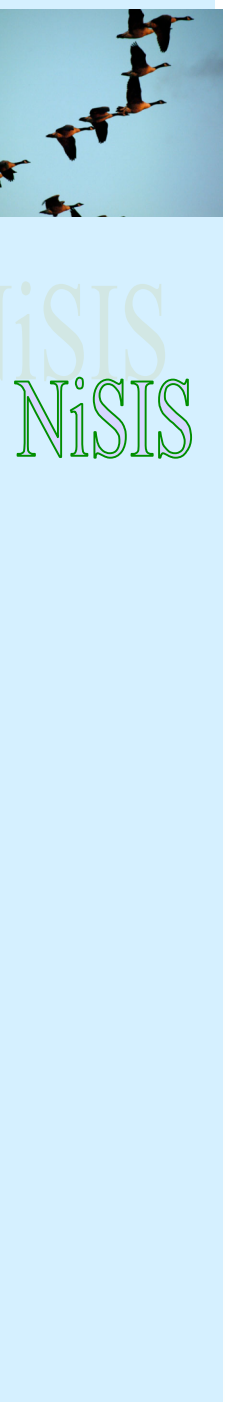
# NiN: Types of network & problems

- fixed - phone, transport, supply / distribution, internet
- ad hoc - wearables, sensors, vehicles, process models, social
- mixed - mobile phone, wireless-fixed , markets
  - routing, robustness, resource allocation, capacity, autonomy (self repair, self c forecasting / diagnosis, efficiency, security, volatility, dynamic behaviour
- information networks - content focus
  - location, access, extraction, distribution, data quality, fusion, hyperlinks (text/vic recommenders, visualisation, clustering
- self-constructing networks - cell interactions
  - where does adaptation come from?
  - how to classify and model dynamic networks (graph theory)
  - how do “regulations” affect outcome?
  - How to design networks to achieve a desired behaviour



# NiN: Nature - inspiration

- disease transmission - epidemic
- ageing
- genetic programming, genetic algorithms, etc
- search - ant colony methods
- learning - reinforcement, Bayes nets
- adaptivity / self-organisation
- neural nets, agent-based systems
- swarm intelligence, flocking
- emergent properties (e.g. cellular automata) - global vs local behaviour
- multi-scale similarities
- multi-function components - organism development, information networks
- economic systems - regulatory systems
- organisational adaptation, social networks



# NiMoC: Contribution of life sciences advanced information systems

- Network architectures
- Modularisation
- Hierarchical structure

Already established in IT

- Repair
- Spatial organisation
  - compartmentation
  - domains
  - multi-functionality of protein complexes
  - structure - function relationships

Potential for novel features and applications in IT

# Living cells perform

## Biochemical reactions

- Catabolic reactions
  - Conversion of substrates into small molecules
  - Generation of free energy
- Anabolic reactions
  - Biosynthesis of complex molecules
    - biocatalytic entities
    - structural elements
    - storage substances

## Information processing

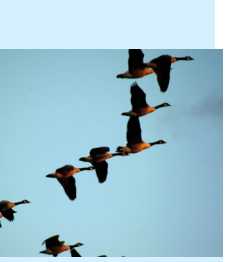
### Regulatory networks

- Control of chemical reactions
- Temporal and spatial coordination of reaction

### Signal transduction networks

- Communication with environment and other cells
- overcome starvation (exogenous and endogenous)

### Spatial organisation of individual reactions - compartmentalisation

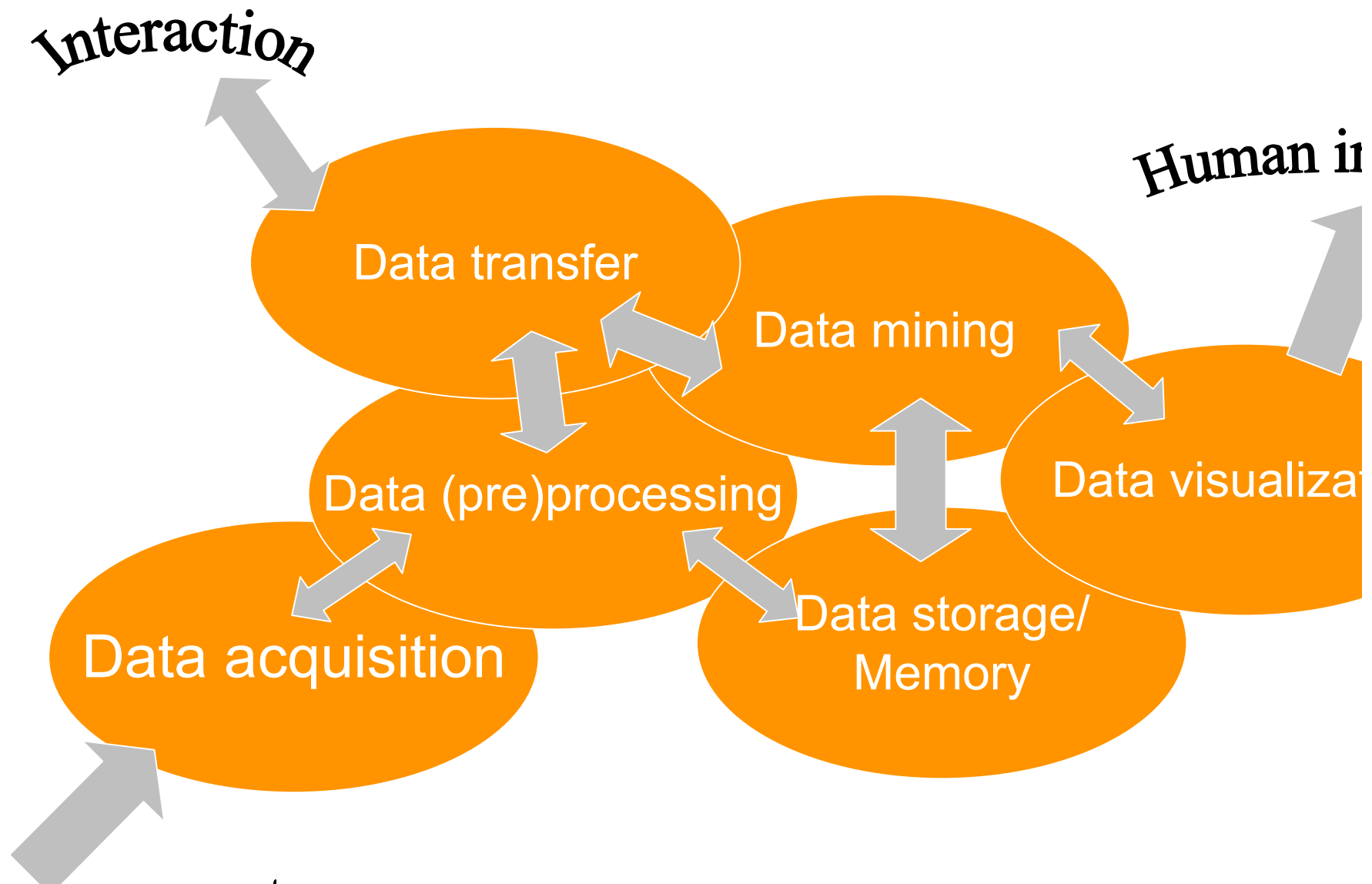


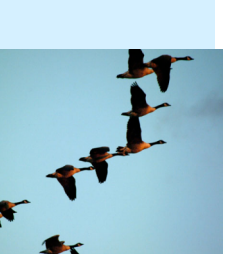
# NiDT: Problems related to Data Technology

- Missing / partial data
- Noisy / uncertain data
- Heterogeneous data
- High dimensionality
- Spatial and temporal issues (e.g. delays)
- Hierarchy / structure
- Representation / Coding
- Compression
- Data flooding



# NiDT: Data Technology – Information flow





# Task Forces

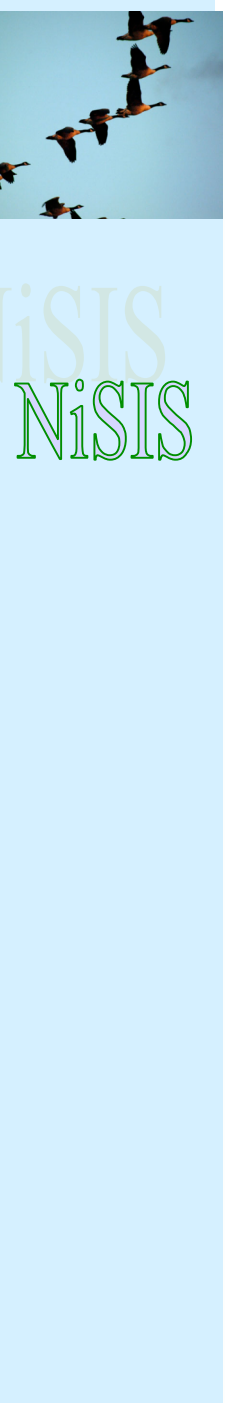
The following Task Forces have been executed during October 2005 – September 2006 and final report will be available soon:

<b>NISSPI – Nature-inspired Self healing Soft Sensors for Process Industry</b>	<b>The origin of adaptability in natural networks</b>	<b>Nature-inspired Cooperative Strategies for Optimization</b>
Leader: Berendsen, Monika	Leader: Monk, Nicholas	Leader: David Pelta
<b>Nature-inspired Monitoring and Control</b>	<b>Potential Nature-inspired Aspects in Information Networks</b>	<b>NICOLE – Nature-inspired Combinatorial Machine Learning</b>
Leader: Bayer, Karl	Leader: Nürnberger, Andreas	Leader: Anguita, Davide

The following new Task Forces have been accepted and started on 01 October, 2006:

<b>Multitasking of Liver Tissues</b>	<b>Physically-inspired Artificial Learning Models (PIALM)</b>	<b>Sparking New Ideas through Brain-like Association Networks</b>
Leader: Sebastian Zellmer	Leader: Dymitr Ruta	Leader: Michael R. Berthold
<b>Immune System-inspired Health Monitoring of Machinery using the Danger Theory</b>	<b>Nature-inspired Methods for Local Pattern Detection</b>	<b>Nature-inspired Robustness</b>
Leader: Jens Strackeljan	Leader: Thomas Seidl	Leader: Rüdiger Brause

# www.nisis.de



NiSIS - Windows Internet Explorer

http://www.nisis.risk-technologies.com/default.aspx

reinhard guthke

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NiSIS HKI - Hans Knöll Institut

Pagina Strumenti

Nature-inspired Smart Information Systems  
Supported by the European Commission

Home Technology Integration Focus Groups Technology Transfer Management & Service Member area

**NiSIS Project**

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- News

**NiSIS**

NiSIS is a European Project initiated by a group of research institutes and we started on 1<sup>st</sup> of February 2005.

The overall mission is to coordinate multi-disciplinary studies and research endeavours into the development and utilisation of intelligent paradigms in advanced information systems.

We are funded by the European Commission and are still looking for new active members.  
You are invited to join us and read more on our web site.



**NiSIS News**

**NiSIS Symposium 2006**

**2<sup>nd</sup> European Symposium on Nature-inspired Smart Information Systems**  
29<sup>th</sup> of November – 1<sup>st</sup> of December, 2006 Puerto de la Cruz, Tenerife, Spain

**A look back together with the programme and presentations available here [NiSIS 2006 page](#).**

**NiSIS Glossary**  
The updated version of our [Glossary](#) is available and all members are requested to enter new nature-inspired relevant terms through the [Collaboration Area](#).

**NiSIS/JCB/DFG**

http://www.nisis.risk-technologies.com/default.aspx

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