

## Web Site and Web interface

Deliverable Number:	D21-D27
Delivery Date:	September 2005
Classification:	Public
Partner Owning:	C01 (INFM) CR9 (EPFL)
Contact Authors:	Guido Caldarelli <a href="mailto:Guido.Caldarelli@roma1.infn.it">Guido.Caldarelli@roma1.infn.it</a> Paolo De Los Rios <a href="mailto:Paolo.DeLosRios@epfl.ch">Paolo.DeLosRios@epfl.ch</a>
Project Co-ordinator:	Guido Caldarelli (INFM) <a href="mailto:Guido.Caldarelli@roma1.infn.it">Guido.Caldarelli@roma1.infn.it</a>
Partners:	<b>CO1 (INFM)</b> <u>INFM Italy</u> <b>CR2 (UDRLS)</b> <u>Università "La Sapienza" Italy,</u> <b>CR3 (UB)</b> <u>Universitat de Barcelona Spain</u> <b>CR5 (ENS)</b> <u>École Normale Supérieure, Paris France</u> <b>CR7 (UNIKARL)</b> <u>Universität Karlsruhe Germany</u> <b>CR8 (UPSUD)</b> <u>Université de Paris Sud France</u> <b>CR9 (EPFL)</b> <u>Ecole Polytechnique Fédérale de Lausanne</u> <i>Switzerland</i>



**Project funded by the European Community under the "Information Society Technologies" Programme (1998-2002)**

### **Abstract**

In this report we present the main features of the project Website and the Web interface that has been realised for a presentation and a first analysis of graphs. To discover all the features and to download documents or software the reader might find convenient to connect to <http://www.cosin.org>

## WWW Site

The WWW is one of the easiest way to disseminate information in an economic and yet effective way. Being also the subject of study of this project, it has been natural to devote a large effort of the dissemination actions in the building of a Web site that could help both participants and external people.

### Complexity in Networks

#### Home Page of the European Project COSIN COEvolution and Self-Organization In dynamical Networks

About COSIN

Node 1  
INFM

Node 2  
Roma  
"La Sapienza"

Node 3  
Universidat  
Barcelona

Node 4  
EPFL  
Lausanne

Node 5  
ENS  
Paris

Node 6  
Universitat  
Karlsruhe

Node 7  
Universit   
de Paris Sud

People

Publications

Software

Visualization

Network data

Complexity

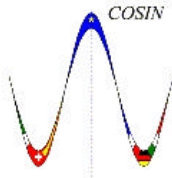
What is Complexity?

Complex networks

What are

Complex Networks?

#### "COMPLEX" NEWS



*Postdoctoral position in complex networks:* We are looking to hire a person with expertise in the analysis and modeling of complex networks to work in the group of Prof. Hernan Makse at City College of New York. The candidate should have a significant publication record and a solid experience in programming in C C++ Fortran. For those interested, please send a CV to Hernan Makse (makse@mailaps.org).



The COSIN project is a FET OPEN Project  
It is funded by EU commission in the priority area of:  
Information Society Technologies



#### The Cosin Project

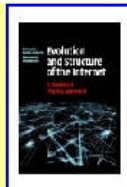
The Cosin Project is a research project aiming to develop statistical models to describe Networks growths and evolution. These models will be based on agents interactions and inspired by the theory of self-organisation and fractal growth.

At the same time, we are thinking to collect data mainly for the Internet and the World Wide Web. These data will be collected in order to validate our models.

We also want to device visualization tools in order to analyze large data sets both from numerical simulations and real world data. Applications to economic networks will be also considered.



Special Issue on  
COSIN Conference



The most beautiful book on  
technological networks

[Home](#) | [Software](#) | [People](#) | [Data](#) | [Related Links](#) | [Publications](#)

[Contact webmaster](#)

Figure 1: The home page of the project at <http://ww.cosin.org>

# Home page

The COSIN home page has been structured in several thematic subsections in order to facilitate the surfing of the site.

At the top of the page the seven *nodes* that have agreed to the COSIN project are showed, clicking on a node will redirect to the homepage of the institution.

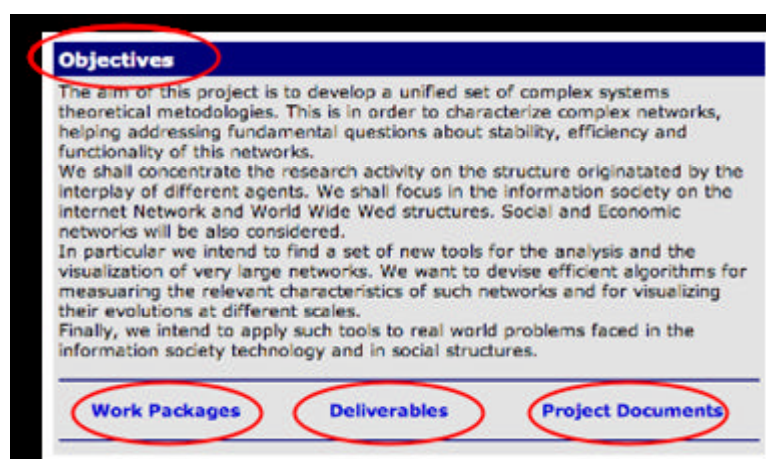
The middle of the page is dedicated to a brief *description* of the COSIN project and to the *news* concerning the world of statistical physics and complex networks.



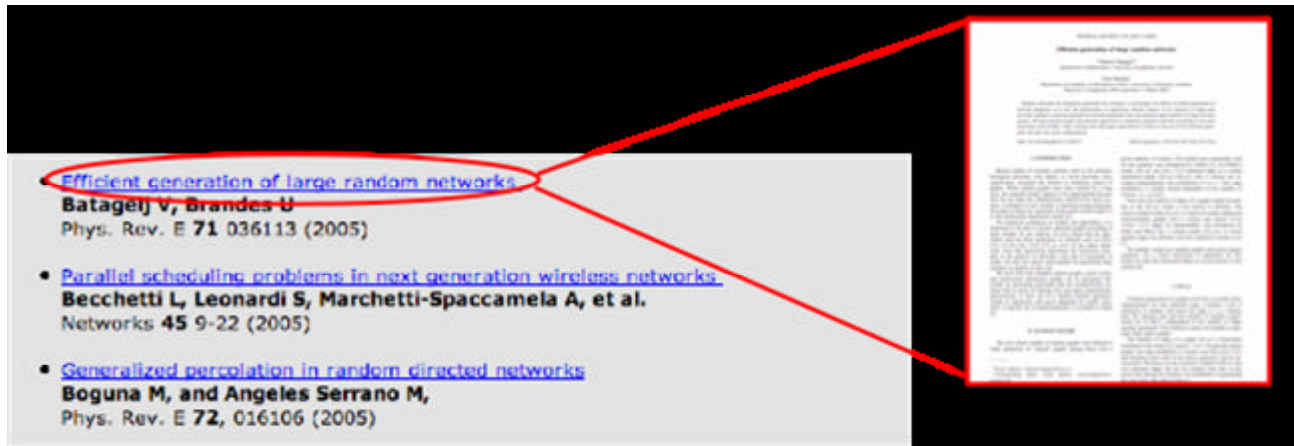
Figure 2: The main links at <http://ww.cosin.org>

At the left of the page an intuitive column bar helps to easily jump between:

- **About COSIN:** The aim and the objectives of the COSIN. From this page it is possible to access the complete list of *Work Packages*, *Deliverables* and *Project Documents*.



- **People:** A list of the people participating and contributing in the COSIN project. Whenever possible a link redirects directly to personal homepages.
- **Publications:** Publications are grouped by year of publication and ordered alphabetically according to the first author surname. Articles are easily accessible and are saved in pdf format.
- **Software:** The tools that have been developed within the COSIN project to



handle, explore, and analyze complex networks.

- **Visualization:** A collection of visualization tools for complex networks.
- **Network data:** Network data sets are grouped into thematic areas and available to download.

## Data sets

The network approach is nowadays applied for the analysis of data as diverse as the internet and the physical interaction of proteins of a living system. For this reason, we have grouped network data sets in three general groups:

- **Technological networks:**

Artificial systems with technological impact: web page sets, internet graphs and traceroutes.

- **Social networks**

Systems of interacting people: actor data sets and u.s. patents. In the first case the network is composed by actors and a link is drawn if two actors happen to have played in the same movie. In the second case we have a directed graph. The vertices are the patents and the edges are citations to a previous patent.

- **Biological networks**

Molecular interaction models of living organisms and interaction between organisms: protein-protein interaction, protein folding, metabolic pathways and food-webs.

## Web Interface

Every data set page includes relevant information concerning the network, including citations if the data

Most of the usage of the data sets is to check their statistical properties in order to validate or introduce new models. Actually, also because of COSIN activity it has been established at least in the field of Statistical Physics a series of basic checks on the statistical properties of data.

Those basic measure are

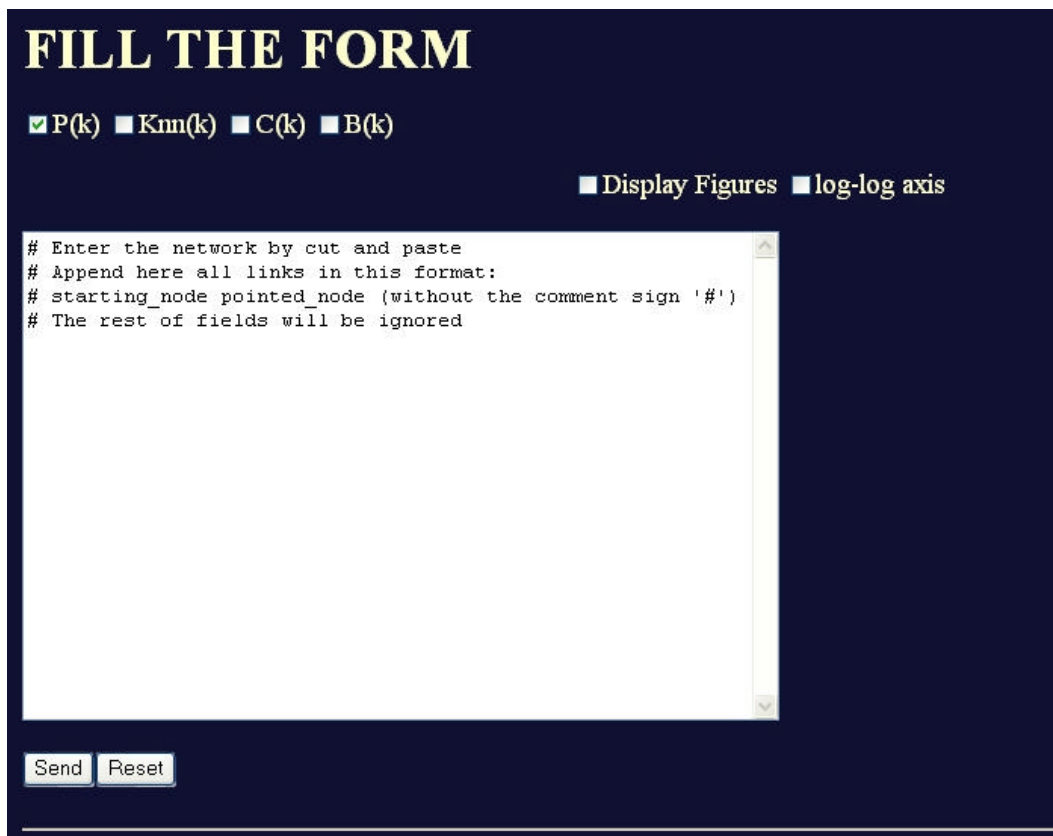
The frequency distribution of the vertices degree

The function  $K_{nn}(k)$  giving the frequency of the average degree of the neighbours of a vertex whose degree is  $k$

The function  $c(k)$  giving the average clustering coefficient of a vertex whose degree is  $k$

The average betweenness of a vertex whose degree is  $k$

In order to help the user of the data collection we realised a form in which this basic analysis can be done automatically not only for the data set stored, but for any data set the user might want to upload on the site.



**FILL THE FORM**

P(k)   $K_{nn}(k)$   C(k)  B(k)

Display Figures  log-log axis

```
# Enter the network by cut and paste
# Append here all links in this format:
# starting_node pointed_node (without the comment sign '#')
# The rest of fields will be ignored
```

Send Reset

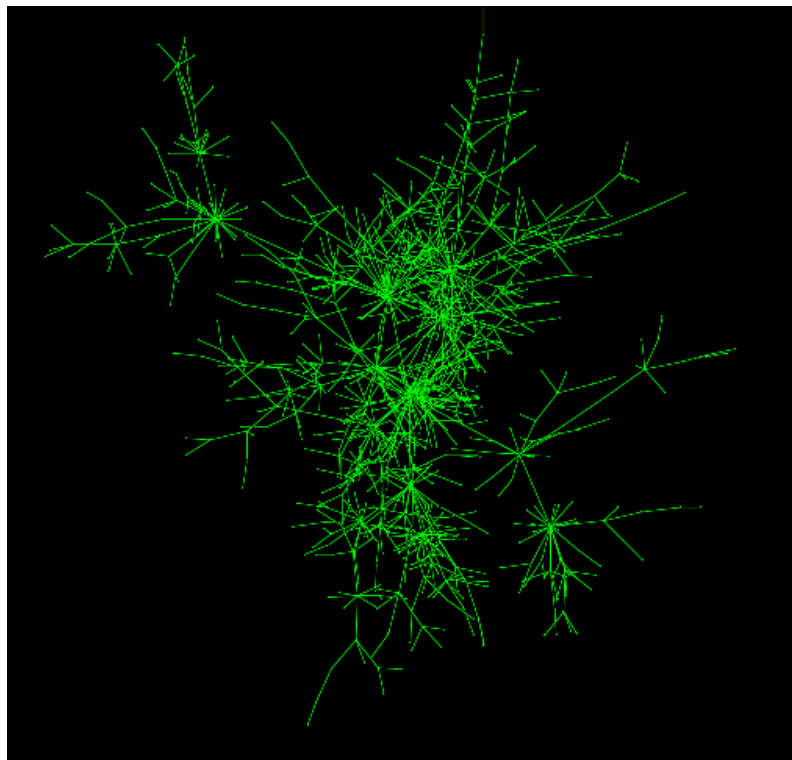
*Figure 3: The FORM to upload the data into the interface*

The method of upload is by cut and paste and the format required is very simple consisting in two different columns the first one for the starting vertex and the second one for the destination one. In order to be able to use other format that specify further information, the other fields (If present) are ignored.

Once introduced the data in the form. the code compute the betweenness of the various vertices using the algorithm made by Ulrik Brandes, computes the degree and the clustering coefficient and plots those file by making use of the open source programme for fitting function xmgrace.

Upon request of the user the images of the plots can be visualized and eventually saved thereby simplifying the work of analysis for the scientists interested in the field of scale-free networks.

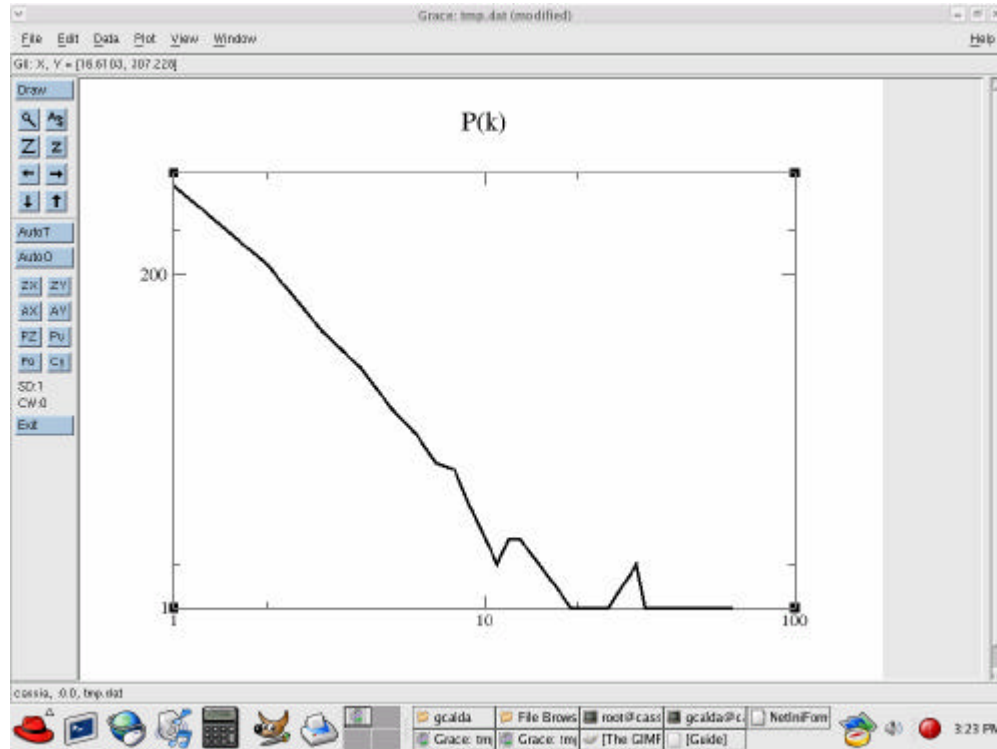
As a simple example of the kind of analysis that can be done we report here a case of study where the user wants to produce a Barabasi-Albert graph of small size (1250 edges). Upon request from the form the code produce automatically the graph and display it on the screen (The figure can be enlarged, and rotated)



*Figure 4 The first output of the code. It represents a Barabasi-Albert “tree” (Actually there is one small cycle of length 3 that is the initial graph. Then the choice of parameter is  $m=1$ , and  $N_0=3$ )*



The first picture that is visualized is the graph itself (see Fig 4). Then according to the user requests we have the further pictures representing the plot of the various statistical quantities



*Figure 5 A screen shot showing the statistical analysis of the data created. The plot is made through the open source code xmgrace running under Linux.*