



EMIS 2001 - A Portal to Mathematics in Progress

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Abstract

The European Mathematical Information Service (EMIS) is the information server network of the European Mathematical Society.

It is based on the voluntary support of several partners from all over the world.

This article gives an overview of concepts behind the service, and its main components: The Electronic Library, the collection of databases, and ongoing projects.

Introduction

Several years ago, the increasing development of electronic devices for the publication of papers and books in mathematics led to a drastic change in the communication process between authors and editors, to new ways of distributing mathematical publications to research mathematicians - like electronic journals, and to an extension of the offers of information on mathematical research to the mathematical community. Today, electronic publishing generally is considered as a must, and the linking facilities offered by electronic versions of mathematical publications in combination with other mathematics offers in the web enable researchers and professionals dealing with mathematics to get the mathematical information and tools they are interested in successfully by browsing and searching. In particular, links going to and provided by literature databases and other qualified indexes help them to find their way through the tremendous bulk of current and previous mathematical research papers and a lot of additional items of interest, like pre-prints, educational material in mathematics, software, graphical material and others.

The aim of this article is to report on those aspects related to methods of electronic publishing and electronic communication by exhibiting offers provided by EMIS (European Mathematical Information Service), calling this accumulation of services and projects a "portal". Clearly, not all features of a comprehensive portal site are offered by EMIS, but the collections provided by the sections dealing with the electronic library, the databases and the projects bundle unique services of high interest for mathematics. Though information on conferences, jobs, society matters etc. can also be obtained from EMIS, the three sections above are the highlights of this service and the subsequent exposition will concentrate on them.

1. The General Concept of EMIS

The idea to develop the European Mathematical Information Service EMIS was born at the meeting of the executive committee of the EMS (European Mathematical Society) in Cortona/Italy, October 1994. The installation of the central server for EMIS began in March 1995 in co-operation with FIZ Karlsruhe at the editorial office of Zentralblatt MATH in Berlin. In June 1995 EMIS went online at the URL <http://www.emis.de/>. This initial installation was extended very soon to the current version of a central server collecting mathematical information and distributing this through a world-wide system of mirror servers.

The World Wide Web access to the contents of EMIS is free for all users, except for the full usage of some databases. In these restricted cases a link leads directly to the corresponding system of database gateways, and the user is subject to the conditions valid for accessing the databases. In any case, users will be able to do searches. But in the case where his institution does not subscribe to the service, only some restricted information will be available from the hit list.

One of the basic ideas for EMIS is distribution through a world-wide system of mirrors where the full content of the service is available at all sites, and updated periodically. This improves the accessibility of EMIS, and it simultaneously is important for the safety of the data and their archiving: if one of the system components fails, it can be regenerated easily from the other components. In principle, every European country has installed one mirror at least, other mirrors have been installed on all continents (except Antarctica).

2. The Electronic Library

The Electronic Library of EMIS (ELibM) aims to present a collection of freely accessible electronic publications which should be as comprehensive as possible. There are four sections: journals, proceedings volumes, monographs, and collected works. In order to guarantee that the electronic publications stored in the Electronic Library meet the quality standards required for articles in traditional print journals, the decision on the inclusion of journals, proceedings or monographs is taken in accordance with the Electronic Publishing Committee of the EMS. Hence, no items will enter the library which have not been evaluated and recommended by a referee within the editorial procedures of the corresponding journal or series. This is in particular important in order to rule out the reservations of many mathematicians who have the opinion that electronic publishing will damage the quality of mathematical publications.

Most of the journals in the Electronic Journals section are completely produced elsewhere, and EMIS only serves as an additional distributor. In some cases, however, the e-journal is produced by EMIS from the original source files provided by the editors. We prefer that the offer of the electronic version is installed at the site of the editors, such that a mirror of the journal can be taken over by EMIS. The organizers of EMIS provide support for this purpose.

The e-journals section contains purely electronic journals as well as electronic versions of print journals (dual journals). Most of the dual journals are published at a low-budget level, and hence the risk of losing subscribers to the print version due to the free electronic offer currently is considered as low by them. Some of them give the electronic offer with a certain delay to EMIS such that the earlier availability will be considered as an advantage of the print version.

Acknowledging that the electronic versions are becoming increasingly important for the users, this delay period will be reorganized. During the period which is considered by dual journals as the

most important one to keep libraries subscribing to them, the access to the electronic version may be provided only to subscribers. To enable the access control for this purpose, the journal will be stored on separate servers, though the metadata should be made freely accessible in ELibM. ELibM will offer links to the complete articles. After a period to be decided by the journals themselves, the full content may be transferred to the system of mirrors of EMIS where it can be read without having a subscription. Such a structure also will support ideas like posting articles "online first", which speeds up the publication procedure considerably.

To get some idea about the journals distributed by ELibM some samples will be mentioned below. The pure electronic journals are marked by an (e):

- Annales Academiae Scientiarum Fennicae Series A. Mathematica (Helsinki)
- Annals of Mathematics
- Archivum Mathematicum (Brno)
- Beitrage zur Algebra und Geometrie / Contributions to Algebra and Geometry
- Commentationes Mathematicae Universitatis Carolinae (Prague)
- DOCUMENTA MATHEMATICA (Bielefeld)
- The Electronic Journal of Combinatorics (e)
- The Electronic Journal of Differential Equations (e)
- Electronic Research Announcements of the AMS (e)
- Electronic Transactions on Numerical Analysis (e)
- Geometry and Topology (e)
- Journal de Theorie des Nombres de Bordeaux (Bordeaux)
- Living Reviews in Relativity (e)
- Matematicki Vesnik (Belgrade)
- Mathematical Physics Electronic Journal (e)
- Revista Colombiana de Matematicas (Bogota)
- Seminaire Lotharingien de Combinatoire

More or less all freely available electronic journals in mathematics are mirrored in ELibM. The total number of journals in ELibM exceeds 50 at present.

The access to the journals in EMIS is organized quite conventionally by clicking through web pages and lists of contents. On the home page of EMIS a list of mirrors is provided where the site with the (probably) best access can be clicked. Then a choice can be made, to enter the Electronic library through the short list of journals without graphics or to use the full display of these items. The first one is preferable, if the choice of journal is clear already and if one wants to avoid the lengthy transfer of the graphical data associated with this journal. The full display contains also background information on the editorial policy of the corresponding journal and instructions how to submit an article. In some cases style files for such a submission can be found on this level.

For all articles DVI- and Postscript-files are available, sometimes also TEX-source codes can be found in addition to that. PDF offers are coming up rapidly and will be obligatory in the near future. By clicking one of these files, the content is transferred to the computer of the user and can be viewed there. Also, printing or storage of these files is possible at the site of the user, but he is requested to respect the copyright policy according to the rules of the corresponding journal. Access to the section of Proceedings Volumes is organized in a similar way.

Admittedly, after six years of EMIS some of these features will have to be modified and modernized. As already mentioned, the request for PDF-files will become a must, because the pre-installed readers at electronic access facilities in libraries and desktop-computers of research

mathematicians already point into that direction. For other offers special measures have to be taken to make the article readable or printable. Decisions about affordable systems of digital object identifiers (beyond DOI) have to be taken to enable a richer linking system between electronic articles. The Zentralblatt MATH accession numbers are one choice for that. These, together with a more standardized set of metadata, will enable the installation of a more professional access structure going beyond just clicking on pages of contents. Such a facility is highly desirable, after having stored such a lot of articles in ELibM, and a first prototype will be available soon.

3. The Databases Section

This section contains four items: MATH - the online version of Zentralblatt MATH, MATHDI - the online version of a similar service for education in mathematics, MPRESS - a global pre-print index, and a database on geometric objects.

To connect EMIS with the database of Zentralblatt MATH is one part of the increasing involvement of the European Mathematical Society in the edition of this reviewing service. In contrast to the variety of "databases" offered by commercial publishers now, the word "reviewing" is taken quite seriously and it is not "abstracting" only. Hence a lot of reviewers are taking part in the evaluation of the literature. All reviewers work for Zentralblatt MATH more or less as volunteers. In addition to independent reviews, other important aspects of quality have to be taken into account like comprehensiveness, precision of data, competent indexing, easy searching, convenient linking with full texts and document delivery systems etc. All these aspects are important features for a reliable service, where quick-and-dirty offers cannot compete, though some of them pretend to have this quality, when their promotion is considered. Mathematics as a science, where the truths detected by mathematicians do not lose their validity with the passing of time, needs such a precision to maintain control over the achievements in the past and to get a reliable information on what is new.

Zentralblatt MATH is published as the conventional printed reviewing service as well as in two electronic offers, one on CD-ROM for off-line use and one as a database with WWW-access. EMIS acts as the the primary mirror site for the WWW-access (<http://www.emis.de/ZMATH>). Additional access is available on mirrors of MATH which have been installed world-wide in Strasbourg, New York, Cornell, Berkeley, Mexico City, Rehovot, Rio de Janeiro, Lecce, Santiago de Compostela and Athens. Clearly, the full service of the database is offered only to subscribers, but it should be mentioned that there is a free component in the Zentralblatt MATH database: Any user of EMIS can do searches in MATH. But non-subscribers only will get information on at most three hits from their list. These hits will be taken from the top of the list, where the most recent items are listed. Hence, if very precise query information is provided which probably leads to a small result list, then this can be reached by everyone who has access to the Internet.

Some brief details on Zentralblatt MATH: It covers information on all mathematical literature, starting in 1931. The total number of documents for which information is stored is about 1,900,000. This increases by more than 70,000 items annually. The update of the database is made every two weeks which corresponds to the production frequency of the print version of Zentralblatt. In addition to mathematics, the scope of publications handled by this service includes mathematical applications in physics, mechanics, statistics, computer science, economics and biology.

Queries can be formulated using the usual list of query fields: author, title, classification, global index, source, language, year of publication, etc. A query can be formulated as logical combinations of these terms. The query formulation is guided by graphical forms, adapted to the user preferences and experience (simple search, advanced search, command line query). In HTML display, mathematical typesetting is available in the TeX source code, but several choices for a convenient

formula display are available (DVI, PS, PDF). Download of the hit list at the users site is possible, and, coming back to the other content of EMIS and other electronic journals and publications, links to the full text of the corresponding article are provided, if this is available electronically. Other options to get the full text of such an article consist of document delivery systems serving for regional or world-wide users. Buttons are used to connect to such delivery services and to see, if the corresponding articles are available. Document delivery can be arranged by these services electronically, by fax, or by sending copies by ordinary mail at reasonable rates.

MATHDI is the online version of the printed service of Zentralblatt fuer Didaktik der Mathematik. It provides comprehensive information on publications in mathematical education. All aspects of quality and search facilities are the same as for Zentralblatt MATH. The editors of the database are the European Mathematical Society and FIZ Karlsruhe. It is supervised by an Editorial Committee. The contents of the database comprises more than 90,000 items.

In contrast to these two for-pay databases, MPRESS is provided as a freely accessible service. It stores combined information on mathematics pre-prints available on the web. The gathering of information is done by robots, which are run by national brokers for harvesting of metadata. This procedure leads to a data structure which only allows for simple search facilities. MPRESS has no ambition to offer a pre-print server itself, only links to full texts are provided. The service is supervised by EMS among others. Countries which support the harvesting are Germany, France, Austria, and Italy. In addition to this some special servers are harvested by MPRESS. Among them are the Topology Atlas and the arXiv.

As a new item, a link to a free offer of high-quality geometric models and animations has been arranged. This is a preliminary version, and it has to be investigated how the data of these models could be stored in a convenient way, to make them accessible within the same menu as is provided for searching mathematical articles. But as a first solution the different entries will be reviewed in Zentralblatt MATH, because they consist of fully peer-reviewed articles on their own, though in contrast to conventional mathematical publications they are providing a lot of geometric enhancements.

4. The Projects

EMS is involved in four projects, where three of them are funded by the European Union and one is funded by Deutsche Forschungsgemeinschaft. The first three are LIMES, EULER, and the Reference Levels project, while the other one is the Jahrbuch-Project. The one closely related to Zentralblatt MATH is LIMES (Large Infrastructures in Mathematics - Enhanced Services).

The objective of the LIMES project is to upgrade the database Zentralblatt MATH into a European-based world class database for mathematics and its applications by a process of technical improvement and wide Europeanization. Upgrading the existing database, improving the present system and developing a new, distributed system both for the input and output of the data are necessary to allow Zentralblatt MATH to use the latest developments and to anticipate future developments of electronic technologies.

The activities of the LIMES partners deal with three areas:

- 1) Improvement of content and retrieval facilities is ongoing, through sophisticated further development of the current data sets and retrieval programs.
- 2) Broader and improved access to the database via national access nodes and new data distribution methods are being implemented. In particular, improvement of access for isolated universities in

regions with economic difficulties and in associated states of Central and Eastern Europe where a mathematical tradition of excellence is under economic threat is one of the goals of this area. Stimulation of usage for all kinds of research as well as for funding organizations before decision making is pursued in the case of two national test sites. 3) Improved coverage and evaluation of research literature via nationally distributed editorial units will be realized, and technologies for efficient database production are being developed for this purpose (exemplified by two further European member states).

From April 1998 to September 2000 the European Commission has been funding the EULER project in the framework of the 'Telematics for Libraries' sector from the Telematics Applications programme. The main goal of EULER was to integrate different, electronically available information resources in the field of mathematics. EULER has constructed a digital library in mathematics from existing heterogeneous sources.

There was, and still is, a rapid increase in the number of networked resources with information on scientific results and ongoing developments in the field of mathematics. Today, the user has to switch between a growing number of systems with heterogeneous user interfaces:

- Scientific literature databases
- Library OPACs and document delivery services
- Electronic journals from academic publishers
- Archives of preprints and grey literature
- Quality controlled subject information gateways on the Internet
- Robot-generated indexes of other relevant Internet resources

These resource types are considered to be the most frequently used when conducting searches for scientific results. They are rarely interconnected and users have to search them one by one.

The aim of the EULER project was to offer a one-stop-shopping site for users interested in mathematics. One single integrated networked-based access point has been developed, covering a representative collection of the mentioned publications-related information resources in mathematics. A common user interface, available on the World Wide Web, allows homogeneous access to all integrated information types. The interface was developed in close cooperation with the mathematical user community. Only one search is necessary to generate a broad range of (mixed) hits, irrespective of resource type and information provider. The EULER services were developed starting with selected important information sources from the consortium partners. The goal was to design an open architecture. New sources of data from other information providers and libraries can be added easily.

The integrated approach makes use of common resource descriptions based on the Dublin Core (DC) element set and access to those descriptions via the Z39.50 protocol. Technically, all information providers have produced DC metadata for their resources and offer them as distributed databases, which are located at the providers' sites. The central EULER Engine queries these databases in parallel via a common Z39.50 profile and performs result set merging, de-duplication, and presentation formatting. The integrated approach takes into consideration the requirements of the user community and the different information providers. Participating institutions are still autonomous in deciding on their scientific and organizational policies, while at the same time providing a common access strategy to their information services. The foremost requirement to achieve such an aim was to choose and apply suitable standards, formats and protocols.

A take-up activity has started in December 2001 with the goal of upgrading the existing prototype service into a European-based world class real virtual library for mathematics (pure and applied) by a process of technological adaptations/consolidations, and implementation of a sustainable business model and its promotion among users and suppliers.

The objective of this new project is to make the EULER service a world reference and delivery service, offering full coverage of the mathematics literature worldwide, including bibliographic data, peer reviews and/or abstracts, indexing, classification and search, transparent access to library services, cooperation with commercial information providers (publishers, bookstores) with a European base.

Based on the achievements of the predecessor project, the EULER service will be consolidated and adapted according to the latest user studies and developments. The EULER-TAKEUP consortium is a small sub-group of partners from the larger EULER Consortium. It will act as a task force of the EULER Consortium to achieve the following specific goals:

- Encourage synergies, accelerate wider adoption and overcome barriers to exploitation by lowering entry barriers for new information providers such as libraries or publishers.
- Adapt, consolidate, and introduce the EULER service model leading-edge technology (now available as prototype) in service applications and carry out a joint evaluation (by supplier and user).
- Continue the wide dissemination of results and exchange experiences across borders and scientific sectors and participation in co-ordination frameworks.

The principal aims of this adaptation of the EULER service will be:

- to make a wide variety of electronic resources in mathematics available through a unified gateway based on the EULER Dublin Core metadata format;
- to continue working toward comprehensiveness, service integration, and cost efficiency of the EULER services;
- to assist in exploiting the benefits of networking for integration of library services such as data sharing and improvement, interlibrary loans, document delivery
- to advance cooperations with commercial partners (publishing houses, bookstores, etc.);
- to create a nonprofit service in the interests of the mathematical community.

The aim of the Jahrbuch-Project, which officially is called ERAM (Electronic Research Archive in Mathematics), is to capture the "Jahrbuch ueber die Fortschritte der Mathematik" as a classical bibliographic service in mathematics in a database and to use this activity to select important publications from the Jahrbuch period (1868-1943) for digitization and storage in a digital archive. The database will not be just a copy of the printed bibliography. It will contain a lot of enhancements like modern subject classifications as far as possible, keywords giving ideas about the contents in modern terms, and comments relating classical results to modern mathematical research areas. These features will remain open for additions within a living project.

The digital archive (built up in connection with the database) covers selected publications as well as whole series going beyond the Jahrbuch period. It will be linked to Zentralblatt MATH and the Jahrbuch database. In the final version all facilities associated with current retrospective digitization projects will be provided. But for the initial period the offer consists of scanned images and metadata for access only. Eventually, the content may be distributed to mirrors and combined with similar archiving activities in mathematics.

Finally, the study "Reference levels in School Mathematics Education in Europe at the age of 16", as it was suggested to the European Commission, identifies "Reference Levels" concerning knowledge and competencies in the domain of mathematics that can become common to all countries in the European Union, and perhaps in other countries.

5. Conclusion

The offers in EMIS mentioned above and their distribution through a system of mirrors provide a unique facility for quick and easy access to qualified mathematical publications. These tools can be used by the mathematical community at suitable sites simultaneously for free or at modest rates. This is an advanced service to provide an alternative to offers of commercial publishers which cannot be afforded by the majority of potential users anymore. Mathematicians have to look for their own systems to maintain a reasonable infrastructure for communicating their research achievements. EMIS is one part of this enterprise.

It has to be pointed out that EMIS cannot survive on the current level without the big group of its supporters, who serve as volunteers for maintaining and installing electronic journals, caring about submissions and transfer of content and keeping the mirrors running. Without these activities EMIS would not have been possible. This shows that a viable service can be maintained with the collaboration of several volunteers, in contrast to those who argue that all these activities can only be pursued seriously on a commercial level. At least in mathematics, the publication cycle relies on voluntary services from the mathematical community: publishers do not pay for receiving the articles from the authors, editors of journals and proceedings volumes provide their service for free, referees do not even get the mailing expenses for their contribution to evaluate the papers, and finally readers have to look for public funding to pay for the access to the publications. Hence the question is only where to shift the voluntary support and where to spend the funding.

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