NATIONAL SERBIAN DIGITIZATION PROJECT: ITS ACHIEVEMENTS AND ACTIVITIES

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Abstract. The aim of this paper is to present the efforts in the area of digitization and digital preservation of scientific and cultural heritage of a group of Serbian scientists from the Faculty of Mathematics of the University of Belgrade and the Mathematical Institute of the Serbian Academy of Science and Art. Virtual library, the repository of digitized books and other works of Serbian authors and E-Library of Serbian mathematical journals are presented.

1. INTRODUCTION

For almost fifteen years there is a group of mathematicians in Belgrade which is active in the area of digitization. The members of the group are mainly from the Faculty of Mathematics of the Belgrade University and the Mathematical Institute of the Serbian Academy of Science and Art. The starting point of this group is that digitized scientific works are one of the most helpful resource and tool for scientific works and fast exchange of scientific information. Also, we understand that every scientific work becomes after some time the part of history and the part of cultural heritage as well. So, our activities are oriented in building of electronic repositories of digitized books, journals and other scientific works.

This group is also active in other areas related to digitization. They built several databases containing digitized materials. Some of these Internet oriented databases are the largest ones in Serbia and probably in the whole Balkan area. We founded an informal organization, the National Center for Digitization (NCD) which gathered several Serbian leading institutions in science and culture (Faculty of Mathematics of the University of Belgrade, Mathematical Institute of the Serbian Academy of Science, National Library, National Museum and Serbian Archive). In spite of the fact that NCD is an informal organization, NCD is the main driver of many activities in the area of digitization in Serbia. It started in 2003 the journal *NCD Review*. Until now 16 volumes of the journal were published. Under the auspices of NCD nine national and three international

conferences were organized since 2000. It is one of the founders of SEEDI, the South East European Digitization Initiative, and the seat of the messenger of SEEDI, *SEEDI communications*, is in Belgrade. In fact, *SEEDI Communications* is the second name of *NCD Review*. Finally, more than fifty papers were written by this group on the technical issues appearing in digitization and on digitized works.

The activities of this group have been supported since 1995 by the Serbian Ministry of Science through the technological projects. Up to now there were four such projects, the last one, *Applications of information technologies in digitization of the scientific and cultural heritage* is still running (up to end of 2010). In the next sections we shall describe two subprojects related to digitization of the scientific heritage.

2. VIRTUAL LIBRARY - DATA BASE OF TEXTUAL DATA, http://elibrary.matf.bg.ac.rs

Aritmetika, 1767
Vasilije Damjanović

There are a large number of rare books in Serbian public and private libraries. For the purpose of our project, we made an electronic catalog according to librarian standards of almost 500 books (published until the beginning of the 20th century) in possession of the Faculty of Mathematics in Belgrade. Just a few of them can be found in the joint catalogue of the network of the largest Serbian libraries (National Library, all university libraries, etc.). This was one of the reasons why we started the project of retro-digitization of mathematics-related works.

Around 1995, we digitized the collected works of the prominent Serbian mathematician Bogdan Gavrilović (1864–1947). Gavrilović obtained doctor's degree in mathematics in 1887 at the Philosophical Faculty of the University in Budapest. He was appointed professor at the University of Belgrade, two times elected president of the Serbian Academy of Sciences (1931–1937), a member of Circolo matematico di Palermo, and doctor honoris causa of the University of Athens. He published two voluminous university textbooks which had the character of monographs: *Analytical Geometry* (1896) and *Theory of Determinants* (1899). Those books, together with his theses (in Hungarian), other papers and archive were digitized (1996–2001), put first in TEX frame, then in PDF, and published as a compact disk. Even if he introduced several mathematical disciplines in the studying at the university level, particularly algebra and geometry, he was almost forgotten by the modern Serbian

mathematicians. This is the reason why we decided to digitize his works. This collection was the first retro-digitized corpus of the books in Serbia.

Besides the collected works of Bogdan Gavrilović, there are also collections devoted to other prominent Serbian scientist. Let us mention in this context the astronomers Đorđe Stanojević, Vojislav Mišković and Milutin Milanković.

The further steps in our work were related to the development of a digital library as a comprehensive and semantically interconnected collection of retro-digitized materials satisfying some of the following criteria:

- Books and manuscripts selected for digitization should be related with mathematical

sciences: mathematics, mechanics, astronomy, physics, mathematical geography etc.

- Books considered for digitization had to be published before certain date in the past. We have chosen for this date the beginning of the World War II. (1941).

- Preference is given to Serbian authors, or to written works related to the area of Balkan.

So far, about 800 books, theses and manuscripts have been digitized, including first two books on mathematics written in Serbian language:

- Vasilije Damjanović, *Aritmetika* (*Arithmetics*), Venice, 1767, and
- Jovan Došenović, *Čislenica* (*Arithmetics*), Budim, 1809.

These two textbooks are very elementary, and their authors did not pretend to be original. They are, however, important for the cultural history of the Serbian people. For example *Čislenica* was the only printed textbook used in the Big School in Belgrade, in the first state created by the Serbian Revolution at the beginning of the 19th century. Thus, it could be considered the first Serbian university textbook, because the Big School is the forerunner of the University of Belgrade. Other digitized materials are works of Ruđer Bošković (1711–1787), two books of the famous Serbian scientist (mechanic, mathematician and astronomer), Milutin Milanković, including his celebrated work *Kanon Der Erdbestrahlung* (1935, 1941), all doctoral dissertations of old Serbian mathematicians (8), including the oldest one: Dimitrije Danić, *Conforme Abbildung des Elliptischen Paraboloids auf die Ebene*, Inauguration dissertation der Philosoph. Fakultaet zu Jena, printed in Belgrade, 1885.

Some of these theses were translated and whenever it was possible, the related documentation (biographies, archive materials, etc.) was also included. The

Internet presentation of this material can be found in the Virtual library. At the same address, part of the presentation and database contain more or less recent (published and unpublished) doctoral and master theses earned at the Faculty of Mathematics in Belgrade. The council of the Faculty decided in 2007 that all submitted theses must be given also in the digital form, so we expect that this part of the database will grow significantly in the next period. Now, there are in the Virtual library 360 doctoral dissertations of Serbian mathematicians of about 500.

An important collection of the Virtual library contains more than fifty Serbian books on astronomy. The oldest books from these collection were written in the XVIII century (books written by Zacharie Orfelin Stefanović (1726-1785), and Ruđer Bošković). The authors of other books are Atanasije Stojković (1773 - 1832), Đorđe Stanojević (1858 -1921), Milan Andonović (1849 -1926), Kosta Stojanović (1867 - 1921), Vojislav Mišković (1892–1976), Pavle Vujević (1881–1966), Tatomir Anđelić (1903-1993) and Jovan Simovljević (1929–2007). More details on this collection the reader can find in Pejović (2011).

The access to the Virtual library is free and open via Internet to the general public. There are about fifty visits to the Virtual Libray daily from all parts of the World.

3. E-LIBRARY OF SERBIAN MATHEMATICAL JOURNALS, http://elib.mi.sanu.ac.rs

Digitization of mathematical journals printed in Serbia started in 1995 with the oldest (founded in 1932) and most important one - *Publications de l'Institut Mathématique*. Until the Second World War it was published by the Belgrade University, and afterwards by the Mathematical Institute. More than 2000 articles appeared in about 100 volumes. The scope of the journal in the beginning was broader, including not only mathematics, but also papers from mechanics and astronomy. Almost every Serbian mathematician published there at least one paper, as well as many world leading mathematicians (Henri Lebesgue, Paul Montel, Waclaw Sierpinski, Paul Erdős, Saharon Shelah, Johan van Benthem, etc.). The first archiving technique was retyping articles using TeX. About 25 volumes (published between 1982 and 1995) were electronically archived in that way. The archive was very compact, having less than 100 MB. It included source (TeX) and output (device independent – DVI, and PDF) files. The archive has been permanently enlarged by adding all new volumes until these days. This archive is included in the Electronic Library of Mathematics (ELibM) offered through EMIS (European Mathematical Information Service, Mijajlović, 2003; Mijajlović et al., 2010).

However, since archiving using TEX system was expensive, it was decided that the remaining old volumes would be scanned. So, in 2007, the rest (since 1932) of *Publications* were completely retro-digitized. In the same period another journal, *Publications of the Faculty of Electrical Engineering, Series Mathematics and Physics* (today called *Applicable Analysis) and Discrete Mathematics*, was

also retro-digitized (about 1000 papers). It was founded in 1956. In the beginning, each contribution appeared separately bound and numbered consecutively, several times a year. Since 1959, the issues have been appearing collected in one or more volumes per year. In the first years, the journal had contributions from different fields apart from mathematics: physics, mechanics, and electrical engineering, but in the course of time, the journal focused almost exclusively on mathematics, especially convexity, functional equations and differential equations. It repository currently contains 285 issues with 3762 articles.

As Internet became more and more popular, in the year 2002 we decided to create an Internet database and the corresponding presentation of freely accessible full-text mathematical journals. The following journals have been involved so far:

- *Publications de l'Institut Mathématique*, Mathematical Institute in Belgrade (since 1932),

- *Bulletin, Classe des Sciences Mathématiques et Naturelles, Sciences mathématiques*,

   Serbian Academy of Sciences and Arts (since 2001),

- *Kragujevac Journal of Mathematics*, Faculty of Sciences Kragujevac (since 2000),

- *Matematički Vesnik*, Mathematical Society of Serbia (35 volumes, since 1993),

- *Nastava Matematike*, Mathematical Society of Serbia (since 1992, in Serbian),

- *Review of the National Center for Digitization*, Faculty of Mathematics in Belgrade and

   National center for digitization (since 2002),

- *Teaching of Mathematics*, Mathematical Society of Serbia (since 1998),

- *Publications of Department of Astronomy,* Faculty of Mathematics in Belgrade (the whole

   period of publishing the journal1969-1990),

- *Zbornik radova*, Mathematical Institute in Belgrade (since the first volume, 1952).

The corresponding presentations of journals are dynamically generated from the database and can be searched (both in English and Serbian) by: authors' names, titles, titles of special sections within the journals, key words and words contained in abstracts, classification numbers, and downloaded and printed. The last version of the database and presentation of mathematical journals is given at the address

   http://elib.mi.sanu.ac.rs, while the retro-digitized journal can be found on
   http://pefmath2.etf.bg.ac.rs.

Since 1999 Mathematical Institute publishes the journal *Visual Mathematics* (Ognjanović, 2003) with the goal to show the beauty of mathematics in a broad artistic-scientific context. It was one of the first journals appearing in digital form

only. All 39 volumes of the journal are available at http://www.mi.sanu.ac.rs/vismath.

Other activities

Our activities are not limited only to retro-digitization of printed matter, books and journals. We shall mention shortly other undertakings of our group.

Electronic catalog of cultural monuments in Serbia, http://spomenicikulture.mi.sanu.ac.rs. site includes various data, including GIS data and tracks (electronic paths) for more than 1500 most important monuments in Serbia (monasteries, archeological sites, historical sites). This is the most comprehensive Serbian Internet site of this kind and many there presented cultural monuments includes several hundred descriptions, data and other items. In recent years members of the Faculty of Natural Sciences of the University in Priština, now situated in Kosovska Mitrovica joined our project. They gave valuable contributions concernig digtization of cultural values in Kosovo and Metohia and Toplica region.

Clippings of Nikola Tesla, http://virlib.matf.bg.ac.rs/tesla. Nikola Tesla (1856-1943) is the great electrical engineer and inventor, world famous for his discoveries and innovations in the everyday use of electric power and electromagnetism. In Belgrade there is a museum devoted to Nikola Tesla. In the possession of the museum there are 57 books of clippings from news papers and professional journals related to science and collected by Tesla himself. Several members of the groups developed Internet oriented software and data base for the presentation of these clippings.

4. MEMBERS OF THE PROJECT

The members of the group are the specialists in the various areas of science. Here are the names of the professors of the Belgrade University and the senior researchers from the institutes of the Serbian Academy of Science, the members of the group: Žarko Mijajlović (mathematician, project leader), Zoran Ognjanović (mathematician), Nadežda Pejović (astronomer), Miomir Korać (archeologist), Dragan Blagojević (mathematician), Dragi Radojević (mechanics), Dragan Radovanović (geographist), Vesna Vučković, Nenad Mitić and Saša Malkov (computer scientists). The members of the project are also several graduate students and programmers: Aleksandar Pejović, Nadica Đorđević, Tijana Zečević and Aleksandar Valjarević.

5. CONCLUSION

The presented subprojects are oriented towards *Digital mathematical library*, a World project on which works many World institutions. The final aim of this project is the fulfillment of a mathematical dream of a digital archive containing

all peer reviewed mathematical literature ever published, properly linked and validated and verified.

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Ognjanović, Z.: 2003, *NCD Review*, **1**, 3.
Pejović, N., et al.: 2011, this Proceedings.

Related Internet sites

Virtual library: http://elibrary.matf.bg.ac.rs
eLibrary of mathematical journals: http://elib.mi.sanu.ac.rs
NCD Review: http://elib.mi.sanu.ac.rs/pages/browse_publication.php?db=ncd
NCD: http://www.ncd.org.rs
SEEDI: http://seedi.ncd.org.rs