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**Курсовая работа на тему**

# Разработка макропакетов для систем TEX и METAPOST

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## BACKGROUND

Producing useful on-line technical texts requires more than just good typesetting. Most technical documents are heavily cross-referenced, and constant flipping from a reference in the text—to the index—to the text referenced in the index—back to the original text makes for tiresome reading. Therefore on-line material will greatly benefit from extending cross references with electronic link (aka "hypertext link") capabilities. Ideally any instance of a term within the text has to be electronically linked to the term's definition contained somewhere else within the document.

The typesetting part can be perfectly handled by TEX, a typesetting engine developed by Donald E. Knuth and described in his book [Knu86]. It is almost universally accepted for typesetting of mathematics, physics and other scientific texts, and is regarded by many as a reference typesetting engine. Large community of TEX users is organized into TUG (TEX Users Group), which provides high-quality technical assistance on all aspects of using TEX and TEX derivatives through a number of TEX-related mailing lists and news groups.

Many modern distributions of TEX provide easy means for producing Adobe's Portable Document Format (or `.pdf`) files. This format supports hypertext links and is platform-independent, i.e., it guarantees identical output by compliant viewers regardless of hardware / operating system used to create it (see [Ado99]). There exist both free of charge (`Acrobat Reader` by Adobe Systems Incorporated) and free / open source (`Xpdf` by Glyph & Cog, LLC) `.pdf` file viewers.

This document describes an attempt to produce a `.pdf` file containing hypertext links supported by the format, using TEX as a typesetting engine.

## I EXISTING SOLUTIONS

I will not consider non-TEX-based solutions because they are mostly inadequate for typesetting mathematics, and the latter is my main concern.

For TEX-based solutions, two different approaches are appropriate which work on different levels:

1) package based on plain TEX (original macro package developed by Donald E. Knuth, see [Knu86]) or LATEX (popular macro package for TEX, see [OPHS02]), typeset by the "original" TEX engine;
2) solution based on a new engine derived from TEX, which supports direct `.pdf` file output.

Examples of both approaches follow.

### 1.1 `hyperref` package

Quoting [Rah98]:

> "... [`hyperref`] *extends the functionality of all the LATEX cross-referencing commands (including the table of contents, bibliographies, etc.) to produce* `\special` *commands which a driver can turn into hypertext links; it also provides new commands to allow the user to write* ad hoc *hypertext links, including those to external documents and URLs ...*"

This is a LATEX-based macro package, and can be used either with the "original" TEX (in which case `\special` commands for `dvips`, `ps2pdf` or some other `.dvi` and `.ps` converters are imbedded into produced `.dvi` file), or with typesetting engines derived from TEX which produce `.pdf` files directly (`pdftex`, `vtex`).

### 1.2 pdfTEX

This is a typesetting engine derived from TEX. It extends TEX's set of primitive command sequences with commands to generate hypertext links (among other features). However, these commands are arcane and require user friendly wrappers (see [TRH00]). Otherwise pdfTEX is fully compatible with TEX and can be used to process any existing macro package including plain TEX and LATEX.

## II PROPOSED SOLUTION

This section describes solution I came up with based on the above findings.

### 2.1 Rationale

Examples of the previous section show that existing solutions either require LATEX (e.g., `hyperref`) or are too "low-level" to be used by an end user (e.g., pdfTEX). Any user of LATEX will be perfectly happy with the first approach, while plain TEX users are out of luck as no packages exist to extend plain TEX with hypertext cross referencing.

Being a plain TEX user myself, I decided to develop a set of wrappers around pdfTEX's extended primitives, which will allow hypertext linking with plain TEX.

### 2.2 Eplain package

Developing all cross-referencing macros from scratch is rigorous undertaking in itself. Fortunately, for many years Eplain package has been providing these and many other

facilities to plain TEX users (see [BS00]), although without any support for pdfTEX's hypertext link commands.

### 2.3 Main idea of the solution

My main idea was to use macros provided by Eplain package and extend them with hypertext linking.

## III IMPLEMENTATION

In this section I describe implementation of the proposed solution. As I needed a test bed for my work, I decided to typeset a math book using the new macros. The book is included in Appendix.

### 3.1 Directory structure and overview of files

Project's top-level directory `elsgolts.diff.ur.var.is` contains the following files and subdirectories:

| | |
|---|---|
| `Makefile` | Makefile of the project; |
| `ChangeLog` | log of changes of the project; |
| `elsgolts.diff.ur.var.is.bib` | BIBTEX database for the test book; |
| `elsgolts.diff.ur.var.is.mst` | MakeIndex style file for the test book; |
| `elsgolts.diff.ur.var.is.tex` | main file of the test book; |
| `foreword.tex` | foreword of the test book; |
| `intro1.tex` | introduction to Part 1 of the test book; |
| `ch1.tex` | Chapter 1 of the test book; |
| ... | ... |
| `ch5.tex` | Chapter 5 of the test book; |
| `figs/` | directory containing figures for the test book; |
| `ch1.mp` | figures for Chapter 1 of the test book; |
| ... | ... |
| `ch5.mp` | figures for Chapter 5 of the test book; |
| `epdf/` | directory containing macro files; |
| `epdfmac.mp` | main METAPOST macro file; |
| `epdfmac.tex` | main TEX macro file; |
| `epdfbib.tex` | hypertext links support for BIBTEX macros; |
| `epdfbugfixes.tex` | fixes to bugs discovered while working on this project; |
| `epdffont.tex` | fonts for the test book; |
| `epdfidx.tex` | hypertext links support for indexes; |
| `epdfobj.tex` | macros for theorems, lists, footnotes, figures, tables, etc.; |
| `epdfoutl.tex` | macros for generating PDF bookmarks; |
| `epdfstruct.tex` | macros to start chapters, sections, etc., of the test book; |
| `epdftoc.tex` | hypertext links support for table of contents; |
| `epdfxref.tex` | hypertext links support for Eplains's cross-referencing macros; |
| `tools/` | directory containing external (non-TEX) tools; |
| `compilebm.py` | generate PDF bookmarks; |
| `cyr2koi.sed` | convert LATEX-style `\cyr*` commands into koi8-r; |
| `idxuniq.awk` | "uniqify" index terms differing only in PDF link name; |
| `t2filter.c` | translate TEX's screen output in T2 encoding to koi8-r or cp866; |
| `tounicode.py` | translate bookmark texts into Unicode. |

### 3.2 How it works

Where possible, I tried to preserve calling sequence of Eplain's macros. For example, Eplain's `\definexref`, `\xrdef`, `\eqdef` and some other macros are redefined to add

PDF link destination behind the scenes, but otherwise are called exactly like the original Eplain's macros.

Eplain's indexing commands `\sidx` and friends can also be called like original macros, with some care. In Eplain, these macros have support for "page number encapsulators" to produce bold, italicized, slanted, etc., page numbers in the index. But in our context, we want in addition to convert each page number into hypertext. `epdfidx.tex` macro file defines a variety of encapsulators which take care of the hypertext link. When user does not explicitly specify encapsulation macro, `\sidx` and friends add default encapsulator which typesets the page number in current (at the time the page number is produced within the index) typeface as a hypertext link.

On the other hand, adding an optional parameter was appropriate for some macros. For example, `\ref` and friends now take optional parameter, which is a phrase to be included within hypertext link together with cross-reference definition being referenced. Same goes for page references with `\xref`.

There is a number of new command sequences of which the most important are:

1) `\UNPROTECTPDF` and `\PROTECTPDF` respectively disable and enable hypertext features of the redefined macros. Thus, you can prevent a cross reference from being converted into a hypertext link by saying `\UNPROTECTPDF` before the cross-referencing macro (do not forget to `\PROTECTPDF` if you do not plan to disable hypertexts until the end of your book).

2) `\raisedpdfdest` will produce PDF link destination at the specified position in your document.

3) `\startlink` ... `\endlink` will put ... into hypertext link pointing to specified PDF destination, which may have been defined implicitly by, e.g., cross-referencing macros or explicitly by `\raisedpdfdest`. There is also `\starturl` which can be used in place of `\startlink` when you want hypertext link to point to a URL instead of a place in your book.

4) `\fullref` macro will produce correctly resolved reference to a cross reference label depending on the type of the label. For example, for a section label, `\fullref` will produce `\sectionword` followed by section number if that section appears in the same chapter as the current section; however, if the section is referred to from another chapter, `\fullref` will also add chapter number. `\fullref` may also add page numbers as appropriate. This macro depends very much on structure of the test book.

For further details see relevant macro files (comments to the macros contain detailed usage information) and [BS00].

Finally, there are several parameters which control the look and placement of generated hypertext links.

First set of parameters controls how high PDF link's destination is raised off the baseline for various types of destinations (generated implicitly by cross-referencing macros or explicitly by `\raisedpdfdest`). These are `\raiseDestEq` for equation numbers, `\raiseDestFig` for figures, and `\raiseDest` for all other types. These parameters must be macros expanding to TEX's ⟨dimen⟩ specification.

Another parameter, `\linkBorderType`, controls the style of border around hypertext links generated by `\startlink` and `\starturl`. There are three predefined

styles: `\linkBorderSolid` (black solid border), `\linkBorderUnderline` (hypertext is underlined), and `\linkBorderNone` (no border around the links). To set, e.g, solid border type say `\let\linkBorderType=\linkBorderSolid`. You can also define new types analogously to the predefined ones if you need to generate, e.g., colored borders (see [Ado99]).

### 3.3 How it can be used

To start using the macros all you need to do is to define `\pathtomacfiles` to the path to macro files relative to the `.tex` file in which you want to include them, and to `\input` the main macro file `epdfmac.tex`. For example, the test book for this project says the following near the top of the main file of the book:

```
\def\pathtomacfiles{epdf/}
\input \pathtomacfiles epdfmac.tex
```

And use pdfTEX to process your `.tex` files. (`Makefile` of this project will allow you to typeset the test book with TEX if you invoke make as '`make USE_PDFTEX=`', but then the resulting `.pdf` file will contain no hypertext links and no bookmarks.)

### 3.4 How it can be customized

This is not going to be easy, but here are places to check:

1) `epdf/epdfmac.tex` contains definitions of page size and offsets, headline and footline, macros for exercises and answers;
2) `epdf/epdffont.tex` defines fonts used and point size switches;
3) `epdf/epdfobj.tex` contains macros for theorems, lemmas, definitions, remarks, corollaries, examples, footnotes, figure and table displays, and typographic lists;
4) `epdf/epdfstruct.tex` is the place to (re)define major structures of the book (parts, chapters, sections, subsections);
5) `epdf/epdftoc.tex` can be modified to adjust appearance of table of contents;
6) and do not forget to tweak `\fullref` in `epdf/epdfxref.tex` if you plan to use it.

## REFERENCES

Following is a list of publications referred to in this document.


[Ado99] Adobe Systems Incorporated. *Portable Document Format Reference Manual, Version 1.3*, March 11, 1999.

[BS00] Karl Berry and Steven Smith. *Expanded Plain TEX*, November 2000.

[Knu86] Donald E. Knuth. *The TEXbook*. Addison-Wesley, Reading, Massachusetts, 1986. Revised to cover TEX3, 1991.

[OPHS02] Tobias Oetiker, Hubert Partl, Irene Hyna, and Elisabeth Schlegl. *The Not So Short Introduction to LATEX2ε*, December 11, 2002.

[Rah98] Sebastian Rahtz. *Hypertext marks in LATEX: the* `hyperref` *package*, June 1998.

[TRH00] Hàn Thế Thành, Sebastian Rahtz, and Hans Hagen. *The pdfTEX user manual*, January 21, 2000.

## APPENDIX

The rest of this document contains the test book, which is Part I of the book *Дифференциальные уравнения и вариационное исчисление* by L. E. Elsgolts (Л. Э. Эльсгольц) typeset using the format files described above. The book has its own page numbering and it was typeset for A5 media format while this document is in A4, so the book is presented double-sided, two pages per side.

Unfortunately, the printed version misses all the advantages of having hypertext cross references. Therefore electronic version of the book together with the source files and macros needed to generate the book is made available for download from `http://geolsoft.freeshell.org/` under the names

```
elsgolts.diff.ur.var.is/elsgolts_diff_ur_var_is.pdf.gz
elsgolts.diff.ur.var.is/elsgolts_diff_ur_var_is.tar.gz
```

(exact location may change, so browse `http://geolsoft.freeshell.org/`).