

The luamplib package

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Abstract

Package to have metapost code typeset directly in a document with LuaTeX.

1 Documentation

This package aims at providing a simple way to typeset directly metapost code in a document with LuaTeX. LuaTeX is built with the lua mplib library, that runs metapost code. This package is basically a wrapper (in Lua) for the Lua mplib functions and some TeX functions to have the output of the mplib functions in the pdf.

In the past, the package required PDF mode in order to output something. Starting with version 2.7 it works in DVI mode as well, though DVIPDFMx is the only DVI tool currently supported.

The metapost figures are put in a TeX hbox with dimensions adjusted to the metapost code.

Using this package is easy: in Plain, type your metapost code between the macros `\mplibcode` and `\endmplibcode`, and in L^AT_EX in the `mplibcode` environment.

The code is from the `luatex-mplib.lua` and `luatex-mplib.tex` files from ConTeXt, they have been adapted to L^AT_EX and Plain by Elie Roux and Philipp Gesang, new functionalities have been added by Kim Dohyun. The changes are:

- a L^AT_EX environment
- all TeX macros start by `mplib`
- use of `luatexbase` for errors, warnings and declaration
- possibility to use `btex ... etex` to typeset TeX code. `texttext()` is a more versatile macro equivalent to `TEX()` from `TEX.mp`. `TEX()` is also allowed and is a synonym of `texttext()`.

N.B. Since v2.5, `btex ... etex` input from external mp files will also be processed by `luamplib`.

N.B. Since v2.20, `verbatimtex ... etex` from external mp files will be also processed by `luamplib`. Warning: This is a change from previous version.

Some more changes and cautions are:

\mplibforcehmode When this macro is declared, every mplibcode figure box will be typeset in horizontal mode, so \centering, \raggedleft etc will have effects. \mplibnoforcehmode, being default, reverts this setting.

\mpliblegacybehavior{enable} By default, \mpliblegacybehavior{enable} is already declared, in which case a verbatimex ... etex that comes just before beginfig() is not ignored, but the T_EX code will be inserted before the following mplib hbox. Using this command, each mplib box can be freely moved horizontally and/or vertically. Also, a box number might be assigned to mplib box, allowing it to be reused later (see test files).

```
\mplibcode
verbatimex \moveright 3cm etex; beginfig(0); ... endfig;
verbatimex \leavevmode etex; beginfig(1); ... endfig;
verbatimex \leavevmode\lower 1ex etex; beginfig(2); ... endfig;
verbatimex \endgraf\moveright 1cm etex; beginfig(3); ... endfig;
\endmplibcode
```

N.B. \endgraf should be used instead of \par inside verbatimex ... etex.

By contrast, T_EX code in VerbatimTeX(...) or verbatimex ... etex between beginfig() and endfig will be inserted after flushing out the mplib figure.

```
\mplibcode
D := sqrt(2)**7;
beginfig(0);
draw fullcircle scaled D;
VerbatimTeX("\gdef\Dia{" & decimal D & "}");
endfig;
\endmplibcode
diameter: \Dia bp.
```

\mpliblegacybehavior{disable} If \mpliblegacybehavior{disabled} is declared by user, any verbatimex ... etex will be executed, along with btex ... etex, sequentially one by one. So, some T_EX code in verbatimex ... etex will have effects on btex ... etex codes that follows.

```
\begin{mplibcode}
beginfig(0);
draw btex ABC etex;
verbatimex \bfseries etex;
draw btex DEF etex shifted (1cm,0); % bold face
draw btex GHI etex shifted (2cm,0); % bold face
endfig;
\end{mplibcode}
```

About figure box metrics Notice that, after each figure is processed, macro `\MPwidth` stores the width value of latest figure; `\MPheight`, the height value. Incidentally, also note that `\MPllx`, `\MPlly`, `\MPurx`, and `\MPury` store the bounding box information of latest figure without the unit bp.

`\everymplib`, `\everyendmplib` Since v2.3, new macros `\everymplib` and `\everyendmplib` re-define token lists `\everymplibtoks` and `\everyendmplibtoks` respectively, which will be automatically inserted at the beginning and ending of each `mplib` code.

```
\everymplib{ beginfig(0); }
\everyendmplib{ endfig; }
\mplibcode % beginfig/endfig not needed
  draw fullcircle scaled 1cm;
\endmplibcode
```

`\mpdim` Since v2.3, `\mpdim` and other raw \TeX commands are allowed inside `mplib` code. This feature is inspired by `gmp.sty` authored by Enrico Gregorio. Please refer the manual of `gmp` package for details.

```
\begin{mplibcode}
  draw origin--(\mpdim{\linewidth},0) withpen pencircle scaled 4
  dashed evenly scaled 4 withcolor \mpcolor{orange};
\end{mplibcode}
```

N.B. Users should not use the protected variant of `btex ... etex` as provided by `gmp` package. As `luamplib` automatically protects \TeX code inbetween, `btex` is not supported here.

`\mpcolor` With `\mpcolor` command, color names or expressions of `color`/`xcolor` packages can be used inside `mplibcode` environment (after `withcolor` operator), though `luamplib` does not automatically load these packages. See the example code above. For spot colors, `(x)spotcolor` (in PDF mode) and `xespotcolor` (in DVI mode) packages are supported as well.

`\mplibnumbersystem` Users can choose `numbersystem` option since v2.4. The default value `scaled` can be changed to `double` or `decimal` by declaring `\mplibnumbersystem{double}` or `\mplibnumbersystem{decimal}`. For details see <http://github.com/lualatex/luamplib/issues/21>.

Settings regarding cache files To support `btex ... etex` in external `.mp` files, `luamplib` inspects the content of each and every `.mp` input files and makes caches if necessary, before returning their paths to Lua \TeX 's `mplib` library. This would make the compilation time longer wastefully, as most `.mp` files do not contain `btex ... etex` command. So `luamplib` provides macros as follows, so that users can give instruction about files that do not require this functionality.

- `\mplibmakenocache{<filename>[,<filename>,...]}`

- `\mplibcancelnocache{<filename>[,<filename>,...]}`

where `<filename>` is a file name excluding `.mp` extension. Note that `.mp` files under `$TEXMFMAIN/metapost/base` and `$TEXMFMAIN/metapost/context/base` are already registered by default.

By default, cache files will be stored in `$TEXMFVAR/luamplib_cache` or, if it's not available, in the same directory as where pdf/dvi output file is saved. This however can be changed by the command `\mplibcachedir{<directory path>}`, where tilde (`~`) is interpreted as the user's home directory (on a windows machine as well). As backslashes (`\`) should be escaped by users, it would be easier to use slashes (`/`) instead.

\mplibtexttextlabel Starting with v2.6, `\mplibtexttextlabel{enable}` enables string labels typeset via `texttext()` instead of `infont` operator. So, `label("my text",origin)` thereafter is exactly the same as `label(texttext("my text"),origin)`. N.B. In the background, `luamplib` redefines `infont` operator so that the right side argument (the font part) is totally ignored. Every string label therefore will be typeset with current \TeX font. Also take care of char operator in the left side argument, as this might bring unpermitted characters into \TeX .

\mplibcodeinherit Starting with v2.9, `\mplibcodeinherit{enable}` enables the inheritance of variables, constants, and macros defined by previous `mplibcode` chunks. On the contrary, the default value `\mplibcodeinherit{disable}` will make each code chunks being treated as an independent instance, and never affected by previous code chunks.

\mplibglobaltexttext To inherit `btex ... etex` labels as well as `metapost` variables, it is necessary to declare `\mplibglobaltexttext{enable}` in advance. On this case, be careful that normal \TeX boxes can conflict with `btex ... etex` boxes, though this would occur very rarely. Notwithstanding the danger, it is a 'must' option to activate `\mplibglobaltexttext` if you want to use `graph.mp` with `\mplibcodeinherit` functionality.

```
\mplibcodeinherit{enable}
\mplibglobaltexttext{enable}
\everymplib{ beginfig(0);} \everyendmplib{ endfig;}
\mplibcode
  label(btex  $\sqrt{2}$  etex, origin);
  draw fullcircle scaled 20;
  picture pic; pic := currentpicture;
\endmplibcode
\mplibcode
  currentpicture := pic scaled 2;
\endmplibcode
```

\mplibverbatim Starting with v2.11, users can issue `\mplibverbatim{enable}`, after which the contents of `mplibcode` environment will be read verbatim. As a result, except for `\mpdim` and `\mpcolor`, all other \TeX commands outside `btex ... etex` or `verbatimtex ... etex` are not expanded and will be fed literally into the `mplib` process.

luamplib.cfg At the end of package loading, `luamplib` searches `luamplib.cfg` and, if found, reads the file in automatically. Frequently used settings such as `\everymplib` or `\mplibforcehmode` are suitable for going into this file.

There are (basically) two formats for metapost: *plain* and *metafun*. By default, the *plain* format is used, but you can set the format to be used by future figures at any time using `\mplibsetformat{<format name>}`.

2 Implementation

2.1 Lua module

```

1
2 luatexbase.provides_module {
3   name      = "luamplib",
4   version   = "2.20.2",
5   date      = "2019/10/11",
6   description = "Lua package to typeset Metapost with LuaTeX's MPLib.",
7 }
8
9 local format, abs = string.format, math.abs
10
11 local err = function(...) return luatexbase.module_error ("luamplib", format(...)) end
12 local warn = function(...) return luatexbase.module_warning("luamplib", format(...)) end
13 local info = function(...) return luatexbase.module_info ("luamplib", format(...)) end
14

```

Use the `luamplib` namespace, since `mplib` is for the metapost library itself. ConT_EXt uses `metapost`.

```

15 luamplib      = luamplib or { }
16 local luamplib = luamplib
17
18 luamplib.showlog = luamplib.showlog or false
19 luamplib.lastlog = ""
20

```

This module is a stripped down version of libraries that are used by ConT_EXt. Provide a few “shortcuts” expected by the imported code.

```

21 local tableconcat = table.concat
22 local textsprint  = tex.sprint
23 local textprint   = tex.tprint
24
25 local texget      = tex.get
26 local texgettoks = tex.gettoks
27 local texgetbox   = tex.getbox
28 local texruntoks  = tex.runtoks

```

We don’t use `tex.scantoks` anymore. See below reagrding `tex.runtoks`.
`local texscantoks = tex.scantoks`

```

29
30 if not texrun toks then
31   err("Your LuaTeX version is too old. Please upgrade it to the latest")
32 end
33
34 local mplib = require ('mplib')
35 local kpse = require ('kpse')
36 local lfs = require ('lfs')
37
38 local lfsattributes = lfs.attributes
39 local lfsisdir = lfs.isdir
40 local lfsmkdir = lfs.mkdir
41 local lfstouch = lfs.touch
42 local iopen = io.open
43

```

Some helper functions, prepared for the case when l-file etc is not loaded.

```

44 local file = file or { }
45 local replacesuffix = file.replacesuffix or function(filename, suffix)
46   return (filename:gsub("%.[%a%d]+$","")) .. "." .. suffix
47 end
48 local stripsuffix = file.stripsuffix or function(filename)
49   return (filename:gsub("%.[%a%d]+$",""))
50 end
51
52 local is_writable = file.is_writable or function(name)
53   if lfsisdir(name) then
54     name = name .. "_luamplib_temp_file_"
55     local fh = iopen(name,"w")
56     if fh then
57       fh:close(); os.remove(name)
58       return true
59     end
60   end
61 end
62 local mk_full_path = lfs.mkdir or function(path)
63   local full = ""
64   for sub in path:gmatch("(/*[^\n/]+)") do
65     full = full .. sub
66     lfsmkdir(full)
67   end
68 end
69

```

btex ... etex in input .mp files will be replaced in finder. Because of the limitation of MPLib regarding make_text, we might have to make cache files modified from input files.

```

70 local luamplibtime = kpse.find_file("luamplib.lua")
71 luamplibtime = luamplibtime and lfsattributes(luamplibtime,"modification")
72

```

```

73 local currenttime = os.time()
74
75 local outputdir
76 if lfstouch then
77   local texmfvar = kpse.expand_var('$TEXMFVAR')
78   if texmfvar and texmfvar ~= "" and texmfvar ~= '$TEXMFVAR' then
79     for _,dir in next, texmfvar:explode(os.type == "windows" and ";" or ":") do
80       if not lfsisdir(dir) then
81         mk_full_path(dir)
82       end
83       if is_writable(dir) then
84         local cached = format("%s/luamplib_cache",dir)
85         lfsmkdir(cached)
86         outputdir = cached
87         break
88       end
89     end
90   end
91 end
92 if not outputdir then
93   outputdir = "."
94   for _,v in ipairs(arg) do
95     local t = v:match("%-output%-directory=(.+)")
96     if t then
97       outputdir = t
98       break
99     end
100   end
101 end
102
103 function luamplib.getcachedir(dir)
104   dir = dir:gsub("##", "#")
105   dir = dir:gsub("^~",
106     os.type == "windows" and os.getenv("UserProfile") or os.getenv("HOME"))
107   if lfstouch and dir then
108     if lfsisdir(dir) then
109       if is_writable(dir) then
110         luamplib.cachedir = dir
111       else
112         warn("Directory '"..dir.."'" is not writable!")
113       end
114     else
115       warn("Directory '"..dir.."'" does not exist!")
116     end
117   end
118 end
119

```

Some basic MetaPost files not necessary to make cache files.

```

120 local noneedtoreplace = {

```

```

121 ["boxes.mp"] = true, -- ["format.mp"] = true,
122 ["graph.mp"] = true, ["marith.mp"] = true, ["mfplain.mp"] = true,
123 ["mpost.mp"] = true, ["plain.mp"] = true, ["rboxes.mp"] = true,
124 ["sarith.mp"] = true, ["string.mp"] = true, -- ["TEX.mp"] = true,
125 ["metafun.mp"] = true, ["metafun.mpiv"] = true, ["mp-abck.mpiv"] = true,
126 ["mp-apos.mpiv"] = true, ["mp-asnc.mpiv"] = true, ["mp-bare.mpiv"] = true,
127 ["mp-base.mpiv"] = true, ["mp-blob.mpiv"] = true, ["mp-butt.mpiv"] = true,
128 ["mp-char.mpiv"] = true, ["mp-chem.mpiv"] = true, ["mp-core.mpiv"] = true,
129 ["mp-crop.mpiv"] = true, ["mp-figs.mpiv"] = true, ["mp-form.mpiv"] = true,
130 ["mp-func.mpiv"] = true, ["mp-grap.mpiv"] = true, ["mp-grid.mpiv"] = true,
131 ["mp-grph.mpiv"] = true, ["mp-idea.mpiv"] = true, ["mp-luas.mpiv"] = true,
132 ["mp-mlib.mpiv"] = true, ["mp-node.mpiv"] = true, ["mp-page.mpiv"] = true,
133 ["mp-shap.mpiv"] = true, ["mp-step.mpiv"] = true, ["mp-text.mpiv"] = true,
134 ["mp-tool.mpiv"] = true,
135 }
136 luamplib.noneedtoreplace = noneedtoreplace
137

```

format.mp is much complicated, so specially treated.

```

138 local function replaceformatmp(file,newfile,ofmodify)
139   local fh = ioopen(file,"r")
140   if not fh then return file end
141   local data = fh:read("*all"); fh:close()
142   fh = ioopen(newfile,"w")
143   if not fh then return file end
144   fh:write(
145     "let normalinfont = infont;\n",
146     "primarydef str infont name = rawtexttext(str) enddef;\n",
147     data,
148     "vardef Fmant_(expr x) = rawtexttext(decimal abs x) enddef;\n",
149     "vardef Fexp_(expr x) = rawtexttext(\"$^{\"&decimal x&\"}$\") enddef;\n",
150     "let infont = normalinfont;\n"
151   ); fh:close()
152   lfstouch(newfile,currenttime,ofmodify)
153   return newfile
154 end
155

```

Replace btex ... etex and verbatimtex ... etex in input files, if needed.

```

156 local name_b = "%f[%a_]"
157 local name_e = "%f[^%a_]"
158 local btex_etex = name_b.."btex"..name_e.."s*(.)%s*"..name_b.."etex"..name_e
159 local verbatimtex_etex = name_b.."verbatimtex"..name_e.."s*(.)%s*"..name_b.."etex"..name_e
160
161 local function replaceinputmpfile (name,file)
162   local ofmodify = lfsattributes(file,"modification")
163   if not ofmodify then return file end
164   local cachedir = luamplib.cachedir or outputdir
165   local newfile = name:gsub("%W","_")
166   newfile = cachedir .."/luamplib_input"..newfile
167   if newfile and luamplibtime then

```



```

168     local nf = lfsattributes(newfile)
169     if nf and nf.mode == "file" and
170         ofmodify == nf.modification and luamplibtime < nf.access then
171         return nf.size == 0 and file or newfile
172     end
173 end
174
175 if name == "format.mp" then return replaceformatmp(file,newfile,ofmodify) end
176
177 local fh = ioopen(file,"r")
178 if not fh then return file end
179 local data = fh:read("*all"); fh:close()
180

```

“etex” must be followed by a space or semicolon as specified in Lua_T_EX manual, which is not the case of standalone MetaPost though.

```

181 local count,cnt = 0,0
182 data, cnt = data:gsub(btex_etex, "btex %1 etex ") -- space
183 count = count + cnt
184 data, cnt = data:gsub(verbatimt看etex, "verbatim %1 etex;") -- semicolon
185 count = count + cnt
186
187 if count == 0 then
188     needtoreplace[name] = true
189     fh = ioopen(newfile,"w");
190     if fh then
191         fh:close()
192         lfstouch(newfile,currenttime,ofmodify)
193     end
194     return file
195 end
196
197 fh = ioopen(newfile,"w")
198 if not fh then return file end
199 fh:write(data); fh:close()
200 lfstouch(newfile,currenttime,ofmodify)
201 return newfile
202 end
203

```

As the finder function for MPLib, use the kpse library and make it behave like as if MetaPost was used. And replace it with cache files if needed.

```

204 local mpkpse = kpse.new(arg[0], "mpost")
205
206 local special_ftype = {
207     pfb = "type1 fonts",
208     enc = "enc files",
209 }
210
211 local function finder(name, mode, ftype)

```

```

212 if mode == "w" then
213     return name
214 else
215     ftype = special_ftype[ftype] or ftype
216     local file = mpkpse:find_file(name,ftype)
217     if file then
218         if not lfstouch or ftype ~= "mp" or noneedtoreplace[name] then
219             return file
220         end
221         return replaceinputmpfile(name,file)
222     end
223     return mpkpse:find_file(name, name:match("%a+$"))
224 end
225 end
226 luamplib.finder = finder
227

```

Create and load MPLib instances. We do not support ancient version of MPLib any more. (Don't know which version of MPLib started to support `make_text` and `run_script`; let the users find it.)

```

228 if tonumber(mplib.version()) <= 1.50 then
229     err("luamplib no longer supports mplib v1.50 or lower. "..
230         "Please upgrade to the latest version of LuaTeX")
231 end
232
233 local preamble = [[
234     boolean mplib ; mplib := true ;
235     let dump = endinput ;
236     let normalfontsize = fontsize;
237     input %s ;
238 ]]
239
240 local function luamplibresetlastlog()
241     luamplib.lastlog = ""
242 end
243
244 local function reporterror (result)
245     if not result then
246         err("no result object returned")
247     else
248         local t, e, l = result.term, result.error, result.log
249         local log = t or l or "no-term"
250         log = log:gsub("%s+", "\n")
251         luamplib.lastlog = luamplib.lastlog .. "\n" .. (l or t or "no-log")
252         if result.status > 0 then
253             warn("%s",log)
254             if result.status > 1 then
255                 err("%s",e or "see above messages")
256             end
257         end
258     end
259 end

```

```

258     return log
259 end
260 end
261
262 local function luamplibload (name)
263     local mpx = mplib.new {
264         ini_version = true,
265         find_file   = luamplib.finder,

```

Make use of `make_text` and `run_script`, which will co-operate with Lua_{TeX}'s `tex.runtoks`. And we provide `numbersystem` option since v2.4. Default value “scaled” can be changed by declaring `\mplibnumbersystem{double}` or `\mplibnumbersystem{decimal}`. See <https://github.com/lualatex/luamplib/issues/21>.

```

266     make_text   = luamplib.maketext,
267     run_script  = luamplib.runscript,
268     math_mode   = luamplib.numbersystem,
269     extensions  = 1,
270 }

```

Append our own MetaPost preamble to the preamble above.

```

271 local preamble = preamble .. luamplib.mplibcodepreamble
272 if luamplib.legacy_verbatimtex then
273     preamble = preamble .. luamplib.legacyverbatimmpreamble
274 end
275 if luamplib.texttextlabel then
276     preamble = preamble .. luamplib.texttextlabelpreamble
277 end
278 local result
279 if not mpx then
280     result = { status = 99, error = "out of memory" }
281 else
282     result = mpx:execute(format(preamble, replacesuffix(name, "mp")))
283 end
284 reporterror(result)
285 return mpx, result
286 end
287

```

plain or metafun, though we cannot support metafun format fully.

```

288 local currentformat = "plain"
289
290 local function setformat (name)
291     currentformat = name
292 end
293 luamplib.setformat = setformat
294

```

Here, excute each `mplibcode` data, ie `\begin{mplibcode} ... \end{mplibcode}`.

```

295 local function process_indeed (mpx, data)
296     local converted, result = false, {}
297     if mpx and data then

```

```

298     result = mpx:execute(data)
299     local log = reporterror(result)
300     if log then
301         if luamplib.showlog then
302             info("%s",luamplib.lastlog)
303             luamplibresetlastlog()
304         elseif result.fig then

```

v2.6.1: now luamplib does not disregard show command, even when luamplib.showlog is false. Incidentally, it does not raise error but just prints a warning, even if output has no figure.

```

305         if log:find("\n>>") then info("%s",log) end
306         converted = luamplib.convert(result)
307     else
308         info("%s",log)
309         warn("No figure output. Maybe no beginfig/endfig")
310     end
311 end
312 else
313     err("Mem file unloadable. Maybe generated with a different version of mplib?")
314 end
315 return converted, result
316 end
317

```

v2.9 has introduced the concept of “code inherit”

```

318 luamplib.codeinherit = false
319 local mplibinstances = {}
320
321 local function process (data)

```

The workaround of issue #70 seems to be unnecessary, as we use make_text now.

```

if not data:find(name_b.."beginfig%s*%([%+%-s]*%d[%.%d%s]*%)" ) then
    data = data .. "beginfig(-1);endfig;"
end

```

```

322 local standalone = not luamplib.codeinherit
323 local currfmt = currentformat .. (luamplib.numbersystem or "scaled")
324 .. tostring(luamplib.texttextlabel) .. tostring(luamplib.legacy_verbatimtex)
325 local mpx = mplibinstances[currfmt]
326 if mpx and standalone then
327     mpx:finish()
328 end
329 if standalone or not mpx then
330     mpx = luamplibload(currentformat)
331     mplibinstances[currfmt] = mpx
332 end
333 return process_indeed(mpx, data)
334 end
335

```

make_text and some run_script uses LuaTeX's tex.runtoks, which made possible running TeX code snippets inside \directlua.

```
336 local catlatex = luatexbase.registernumber("catcodetable@latex")
337 local catat11 = luatexbase.registernumber("catcodetable@atletter")
338
```

tex.scantoks sometimes fail to read catcode properly, especially \#, \&, or \%. After some experiment, we dropped using it. Instead, a function containing tex.script seems to work nicely.

```

    local function run_tex_code_no_use (str, cat)
        cat = cat or catlatex
        texscantoks("mplibtmptoks", cat, str)
        texruntoks("mplibtmptoks")
    end

339 local function run_tex_code (str, cat)
340   cat = cat or catlatex
341   texruntoks(function() texsprint(cat, str) end)
342 end
343
```

Indefinite number of boxes are needed for btex ... etex. So starts at somewhat huge number of box registry. Of course, this may conflict with other packages using many many boxes. (When codeinherit feature is enabled, boxes must be globally defined.) But I don't know any reliable way to escape this danger.

```
344 local tex_box_id = 2047

    For conversion of sp to bp.

345 local factor = 65536*(7227/7200)
346
347 local texttext_fmt = [[image(addto currentpicture doublepath unitsquare )].
348   [[xscaled %f yscaled %f shifted (0,-%f) ]].
349   [[withprescript "mplibtexboxid=%i:%f:%f"]]]
350
351 local function process_tex_text (str)
352   if str then
353     tex_box_id = tex_box_id + 1
354     local global = luamplib.globaltexttext and "\\global" or ""
355     run_tex_code(format("%s\\setbox%i\\hbox{%s}", global, tex_box_id, str))
356     local box = texgetbox(tex_box_id)
357     local wd = box.width / factor
358     local ht = box.height / factor
359     local dp = box.depth / factor
360     return texttext_fmt:format(wd, ht+dp, dp, tex_box_id, wd, ht+dp)
361   end
362   return ""
363 end
364
```

Make color or xcolor's color expressions usable, with \mpcolor or mplibcolor. These commands should be used with graphical objects.

```

365 local mplibcolor_fmt = [[\begingroup\let\XC@mcolor\relax]]..
366 [[\def\set@color{\global\mplibtmptoks\expandafter{\current@color}}]]..
367 [[\color %s \endgroup]]
368
369 local function process_color (str)
370   if str then
371     if not str:find("{.-}") then
372       str = format("{%s}",str)
373     end
374     run_tex_code(mplibcolor_fmt:format(str), catat11)
375     return format('1 withprescript "MPLibOverrideColor=%s"', texgettoks"mplibtmptoks")
376   end
377   return ""
378 end
379

```

\mpdim is expanded before MPLib process, so code below will not be used for mplibcode data. But who knows anyone would want it in .mp input file. If then, you can say mplibdimen(".5\textwidth") for example.

```

380 local function process_dimen (str)
381   if str then
382     str = str:gsub("{(.+)}", "%1")
383     run_tex_code(format([[ \mplibtmptoks\expandafter{\the\dimexpr %s\relax}]], str))
384     return format("\begingroup %s \endgroup", texgettoks"mplibtmptoks")
385   end
386   return ""
387 end
388

```

Newly introduced method of processing verbatimtex ... etex. Used when \mpliblegacybehavior{false} is declared.

```

389 local function process_verbatimtex_text (str)
390   if str then
391     run_tex_code(str)
392   end
393   return ""
394 end
395

```

For legacy verbatimtex process. verbatimtex ... etex before beginfig() is not ignored, but the T_EX code is inserted just before the mplib box. And T_EX code inside beginfig() ... endfig is inserted after the mplib box.

```

396 local tex_code_pre_mplib = {}
397 luamplib.figid = 1
398 luamplib.in_the_fig = false
399
400 local function legacy_mplibcode_reset ()
401   tex_code_pre_mplib = {}

```

```

402 luamplib.figid = 1
403 end
404
405 local function process_verbatimtex_prefig (str)
406   if str then
407     tex_code_pre_mplib[luamplib.figid] = str
408   end
409   return ""
410 end
411
412 local function process_verbatimtex_infig (str)
413   if str then
414     return format('special "postmplibverbtex=%s";', str)
415   end
416   return ""
417 end
418
419 local runscript_funcs = {
420   luamplibtext    = process_tex_text,
421   luamplibcolor   = process_color,
422   luamplibdimen   = process_dimen,
423   luamplibprefig  = process_verbatimtex_prefig,
424   luamplibinfig   = process_verbatimtex_infig,
425   luamplibverbtex = process_verbatimtex_text,
426 }
427
428 mp = mp or {}
429 local mp = mp
430 mp.mf_path_reset = mp.mf_path_reset or function() end
431 mp.mf_finish_saving_data = mp.mf_finish_saving_data or function() end
432

```

For metafun format. see issue #79.

A function from ConT_EXt general.

```

433 local function mpprint(buffer,...)
434   for i=1,select("#",...) do
435     local value = select(i,...)
436     if value ~= nil then
437       local t = type(value)
438       if t == "number" then
439         buffer[#buffer+1] = format("%.16f",value)
440       elseif t == "string" then
441         buffer[#buffer+1] = value
442       elseif t == "table" then
443         buffer[#buffer+1] = "(" .. tableconcat(value,",") .. ")"
444       else -- boolean or whatever
445         buffer[#buffer+1] = tostring(value)
446       end
447     end
448   end

```

```

449 end
450
451 function luamplib.runscript (code)
452   local id, str = code:match("(.-){(}.+)}")
453   if id and str and str ~= "" then
454     local f = runscript_funcs[id]
455     if f then
456       local t = f(str)
457       if t then return t end
458     end
459   end
460   local f = loadstring(code)
461   if type(f) == "function" then
462     local buffer = {}
463     function mp.print(...)
464       mpprint(buffer,...)
465     end
466     f()
467     return tableconcat(buffer,"")
468   end
469   return ""
470 end
471
472   make_text must be one liner, so comment sign is not allowed.
473 local function protecttexcontents (str)
474   return str:gsub("\\%", "\0PerCent\0")
475         :gsub("%%.-\n", "")
476         :gsub("%%.-$", "")
477         :gsub("%zPerCent%z", "\\%")
478         :gsub("%s+", " ")
479 end
480 luamplib.legacy_verbatimex = true
481
482 function luamplib.maketext (str, what)
483   if str and str ~= "" then
484     str = protecttexcontents(str)
485     if what == 1 then
486       if not str:find("\\documentclass"..name_e) and
487         not str:find("\\begin%s*{document}") and
488         not str:find("\\documentstyle"..name_e) and
489         not str:find("\\usepackage"..name_e) then
490         if luamplib.legacy_verbatimex then
491           if luamplib.in_the_fig then
492             return process_verbatimex_infig(str)
493           else
494             return process_verbatimex_prefig(str)
495           end
496         else

```



```

497         return process_verbatimtex_text(str)
498     end
499 end
500 else
501     return process_tex_text(str)
502 end
503 end
504 return ""
505 end
506

    Our MetaPost preambles
507 local mplibcodepreamble = [[
508 texscriptmode := 2;
509 def rawtexttext (expr t) = runscript("luamplibtext{"&t&}") enddef;
510 def mplibcolor (expr t) = runscript("luamplibcolor{"&t&}") enddef;
511 def mplibdimen (expr t) = runscript("luamplibdimen{"&t&}") enddef;
512 def VerbatimTeX (expr t) = runscript("luamplibverbtex{"&t&}") enddef;
513 if known context_mlib:
514     defaultfont := "cmtt10";
515     let infont = normalinfont;
516     let fontsize = normalfontsize;
517     vardef thelabel@#(expr p,z) =
518         if string p :
519             thelabel@#(p infont defaultfont scaled defaultscale,z)
520         else :
521             p shifted (z + labeloffset*mfun_laboff@# -
522                 (mfun_labxf@#*lrcorner p + mfun_labyf@#*ulcorner p +
523                 (1-mfun_labxf@#-mfun_labyf@#)*llcorner p))
524         fi
525     enddef;
526 def graphicstext primary filename =
527     if (readfrom filename = EOF):
528         errmessage "Please prepare "&filename&" in advance with"&
529             " 'pstoedit -ssp -dt -f mpost yourfile.ps "&filename&"";
530     fi
531     closefrom filename;
532     def data_mpy_file = filename enddef;
533     mfun_do_graphic_text (filename)
534 enddef;
535 else:
536     vardef texttext@# (text t) = rawtexttext (t) enddef;
537 fi
538 def externalfigure primary filename =
539     draw rawtexttext("\includegraphics{"& filename &}")
540 enddef;
541 def TEX = texttext enddef;
542 ]]
543 luamplib.mplibcodepreamble = mplibcodepreamble
544

```

```

545 local legacyverbatimpreamble = [[
546 def specialVerbatimTeX (text t) = runscript("luamplibprefig{"&t&}") enddef;
547 def normalVerbatimTeX (text t) = runscript("luamplibinfig{"&t&}") enddef;
548 let VerbatimTeX = specialVerbatimTeX;
549 extra_beginfig := extra_beginfig & " let VerbatimTeX = normalVerbatimTeX;"&
550 "runscript(" &ditto& "luamplib.in_the_fig=true" &ditto& ");";
551 extra_endfig := extra_endfig & " let VerbatimTeX = specialVerbatimTeX;"&
552 "runscript(" &ditto&
553 "luamplib.in_the_fig=false luamplib.figid=luamplib.figid+1" &ditto& ");";
554 ]]
555 luamplib.legacyverbatimpreamble = legacyverbatimpreamble
556
557 local texttextlabelpreamble = [[
558 primarydef s infont f = rawtexttext(s) enddef;
559 def fontsize expr f =
560   begingroup
561     save size; numeric size;
562     size := mpplibdimen("1em");
563     if size = 0: 10pt else: size fi
564   endgroup
565 enddef;
566 ]]
567 luamplib.texttextlabelpreamble = texttextlabelpreamble
568

```

When `\mplibverbatim` is enabled, do not expand `mplibcode` data.

```

569 luamplib.verbatiminput = false
570

```

Do not expand `btex ... etex`, `verbatimtex ... etex`, and string expressions.

```

571 local function protect_expansion (str)
572   if str then
573     str = str:gsub("\\", "!!!Control!!!")
574           :gsub("%%", "!!!Comment!!!")
575           :gsub("#", "!!!HashSign!!!")
576           :gsub("{", "!!!LBrace!!!")
577           :gsub("}", "!!!RBrace!!!")
578     return format("\\unexpanded{%s}", str)
579   end
580 end
581
582 local function unprotect_expansion (str)
583   if str then
584     return str:gsub("!!!Control!!!", "\\")
585           :gsub("!!!Comment!!!", "%")
586           :gsub("!!!HashSign!!!", "#")
587           :gsub("!!!LBrace!!!", "{")
588           :gsub("!!!RBrace!!!", "}")
589   end
590 end
591

```

```

592 local function process_mplibcode (data)
    This is needed for legacy behavior regarding verbatimex
593     legacy_mplibcode_reset()
594
595     local everymplib    = texgettoks'everymplibtoks' or ''
596     local everyendmplib = texgettoks'everyendmplibtoks' or ''
597     data = format("\n%s\n%s\n%s\n",everymplib, data, everyendmplib)
598     data = data:gsub("\r","\n")
599
600     data = data:gsub("\mpcolor%s+{.-%b{}}","mplibcolor(\\"%1\\)")
601     data = data:gsub("\mpdim%s+{%b{}}","mplibdimen(\\"%1\\)")
602     data = data:gsub("\mpdim%s+(\\"%a+)", "mplibdimen(\\"%1\\)")
603
604     data = data:gsub(btex_etex, function(str)
605         return format("btex %s etex ", -- space
606             luamplib.verbatiminput and str or protect_expansion(str))
607     end)
608     data = data:gsub(verbatimex_etex, function(str)
609         return format("verbatimex %s etex;", -- semicolon
610             luamplib.verbatiminput and str or protect_expansion(str))
611     end)
612

```

If not mplibverbatim, expand mplibcode data, so that users can use \TeX codes in it. It has turned out that no comment sign is allowed.

```

613     if not luamplib.verbatiminput then
614         data = data:gsub("\".-\\\"", protect_expansion)
615
616         data = data:gsub("\\%\"", "\0PerCent\0")
617         data = data:gsub("%%. -\\n", "")
618         data = data:gsub("%zPerCent%z", "\\%")
619
620         run_tex_code(format("\mplibtmptoks\expanded{{%s}}",data))
621         data = texgettoks"mplibtmptoks"
622
        Next line to address issue #55
622         data = data:gsub("##", "#")
623         data = data:gsub("\".-\\\"", unprotect_expansion)
624         data = data:gsub(btex_etex, function(str)
625             return format("btex %s etex", unprotect_expansion(str))
626         end)
627         data = data:gsub(verbatimex_etex, function(str)
628             return format("verbatimex %s etex", unprotect_expansion(str))
629         end)
630     end
631
632     process(data)
633 end
634 luamplib.process_mplibcode = process_mplibcode
635

```

For parsing prescript materials.

```

636 local further_split_keys = {
637   mplibtexboxid = true,
638   sh_color_a    = true,
639   sh_color_b    = true,
640 }
641
642 local function script2table(s)
643   local t = {}
644   for _,i in ipairs(s:explode("\13+")) do
645     local k,v = i:match("(.-)=(.*)") -- v may contain = or empty.
646     if k and v and k ~= "" then
647       if further_split_keys[k] then
648         t[k] = v:explode(":")
649       else
650         t[k] = v
651       end
652     end
653   end
654   return t
655 end
656
```

Codes below for inserting PDF literals are mostly from ConTeXt general, with small changes when needed.

```

657 local function getobjects(result,figure,f)
658   return figure:objects()
659 end
660
661 local function convert(result, flusher)
662   luamplib.flush(result, flusher)
663   return true -- done
664 end
665 luamplib.convert = convert
666
667 local function pdf_startfigure(n,llx,lly,urx,ury)
668   texsprint(format("\mplibstarttoPDF{%f}{%f}{%f}{%f}",llx,lly,urx,ury))
669 end
670
671 local function pdf_stopfigure()
672   texsprint("\mplibstoptoPDF")
673 end
674
```

tex.tprint with catcode regime -2, as sometimes # gets doubled in the argument of pdfliteral.

```

675 local function pdf_literalcode(fmt,...) -- table
676   texprint({"\mplibtoPDF{",{-2,format(fmt,...)},{"}"}))
677 end
678
```

```

679 local function pdf_textfigure(font,size,text,width,height,depth)
680   text = text:gsub(".",function(c)
681     return format("\hbox{\char%i}",string.byte(c)) -- kerning happens in metapost
682   end)
683   texsprint(format("\mplibtexttext{%s}{%f}{%s}{%s}{%f}",font,size,text,0,-( 7200/ 7227)/65536*depth))
684 end
685
686 local bend_tolerance = 131/65536
687
688 local rx, sx, sy, ry, tx, ty, divider = 1, 0, 0, 1, 0, 0, 1
689
690 local function pen_characteristics(object)
691   local t = mplib.pen_info(object)
692   rx, ry, sx, sy, tx, ty = t.rx, t.ry, t.sx, t.sy, t.tx, t.ty
693   divider = sx*sy - rx*ry
694   return not (sx==1 and rx==0 and ry==0 and sy==1 and tx==0 and ty==0), t.width
695 end
696
697 local function concat(px, py) -- no tx, ty here
698   return (sy*px-ry*py)/divider,(sx*py-rx*px)/divider
699 end
700
701 local function curved(ith,pth)
702   local d = pth.left_x - ith.right_x
703   if abs(ith.right_x - ith.x_coord - d) <= bend_tolerance and abs(pth.x_coord - pth.left_x - d) <= bend_tolerance then
704     d = pth.left_y - ith.right_y
705     if abs(ith.right_y - ith.y_coord - d) <= bend_tolerance and abs(pth.y_coord - pth.left_y - d) <= bend_tolerance then
706       return false
707     end
708   end
709   return true
710 end
711
712 local function flushnormalpath(path,open)
713   local pth, ith
714   for i=1,#path do
715     pth = path[i]
716     if not ith then
717       pdf_literalcode("%f %f m",pth.x_coord,pth.y_coord)
718     elseif curved(ith,pth) then
719       pdf_literalcode("%f %f %f %f %f c",ith.right_x,ith.right_y,pth.left_x,pth.left_y,pth.x_coord,pth.y_coord)
720     else
721       pdf_literalcode("%f %f l",pth.x_coord,pth.y_coord)
722     end
723     ith = pth
724   end
725   if not open then
726     local one = path[1]
727     if curved(pth,one) then
728       pdf_literalcode("%f %f %f %f %f c",pth.right_x,pth.right_y,one.left_x,one.left_y,one.x_coord,one.y_coord )

```

```

729     else
730         pdf_literalcode("%f %f l",one.x_coord,one.y_coord)
731     end
732 elseif #path == 1 then -- special case .. draw point
733     local one = path[1]
734     pdf_literalcode("%f %f l",one.x_coord,one.y_coord)
735 end
736 end
737
738 local function flushconcatpath(path,open)
739 pdf_literalcode("%f %f %f %f %f %f cm", sx, rx, ry, sy, tx ,ty)
740 local pth, ith
741 for i=1,#path do
742     pth = path[i]
743     if not ith then
744         pdf_literalcode("%f %f m",concat(pth.x_coord,pth.y_coord))
745     elseif curved(ith,pth) then
746         local a, b = concat(ith.right_x,ith.right_y)
747         local c, d = concat(pth.left_x,pth.left_y)
748         pdf_literalcode("%f %f %f %f %f %f c",a,b,c,d,concat(pth.x_coord, pth.y_coord))
749     else
750         pdf_literalcode("%f %f l",concat(pth.x_coord, pth.y_coord))
751     end
752     ith = pth
753 end
754 if not open then
755     local one = path[1]
756     if curved(pth,one) then
757         local a, b = concat(pth.right_x,pth.right_y)
758         local c, d = concat(one.left_x,one.left_y)
759         pdf_literalcode("%f %f %f %f %f %f c",a,b,c,d,concat(one.x_coord, one.y_coord))
760     else
761         pdf_literalcode("%f %f l",concat(one.x_coord,one.y_coord))
762     end
763 elseif #path == 1 then -- special case .. draw point
764     local one = path[1]
765     pdf_literalcode("%f %f l",concat(one.x_coord,one.y_coord))
766 end
767 end
768
769     dvipdfmx is supported, though nobody seems to use it.
770 local pdfoutput = tonumber(texget("outputmode")) or tonumber(texget("pdfoutput"))
771 local pdfmode = pdfoutput > 0
772
773 local function start_pdf_code()
774     if pdfmode then
775         pdf_literalcode("q")
776     else
777         texsprint("\\special{pdf:bcontent}") -- dvipdfmx

```

```

777 end
778 end
779 local function stop_pdf_code()
780   if pdfmode then
781     pdf_literalcode("Q")
782   else
783     texsprint("\\special{pdf:econtent}") -- dvipdfmx
784   end
785 end
786

```

Now we process hboxes created from `btex ... etex` or `texttext(...)` or `TEX(...)`, all being the same internally.

```

787 local function put_tex_boxes (object,prescript)
788   local box = prescript.mplibtexboxid
789   local n,tw,th = box[1],tonumber(box[2]),tonumber(box[3])
790   if n and tw and th then
791     local op = object.path
792     local first, second, fourth = op[1], op[2], op[4]
793     local tx, ty = first.x_coord, first.y_coord
794     local sx, rx, ry, sy = 1, 0, 0, 1
795     if tw ~= 0 then
796       sx = (second.x_coord - tx)/tw
797       rx = (second.y_coord - ty)/tw
798       if sx == 0 then sx = 0.00001 end
799     end
800     if th ~= 0 then
801       sy = (fourth.y_coord - ty)/th
802       ry = (fourth.x_coord - tx)/th
803       if sy == 0 then sy = 0.00001 end
804     end
805     start_pdf_code()
806     pdf_literalcode("%f %f %f %f %f %f cm",sx,rx,ry,sy,tx,ty)
807     texsprint(format("\\mplibputtextbox{%i}",n))
808     stop_pdf_code()
809   end
810 end
811

```

Colors and Transparency

```

812 local pdf_objs = {}
813 local token, getpageres, setpageres = newtoken or token
814 local pgf = { bye = "pgfutil@everybye", extgs = "pgf@sys@addpdfresource@extgs@plain" }
815
816 if pdfmode then -- repect luaotfload-colors
817   getpageres = pdf.getpageresources or function() return pdf.pageresources end
818   setpageres = pdf.setpageresources or function(s) pdf.pageresources = s end
819 else
820   texsprint("\\special{pdf:obj @MPLibTr<<>>}",
821             "\\special{pdf:obj @MPLibSh<<>>}")
822 end

```

```

823
824 local function update_pdfobjs (os)
825   local on = pdf_objs[os]
826   if on then
827     return on,false
828   end
829   if pdfmode then
830     on = pdf.immediateobj(os)
831   else
832     on = pdf_objs.cnt or 0
833     pdf_objs.cnt = on + 1
834   end
835   pdf_objs[os] = on
836   return on,true
837 end
838
839 local transparency_modes = { [0] = "Normal",
840   "Normal",      "Multiply",    "Screen",      "Overlay",
841   "SoftLight",   "HardLight",   "ColorDodge",  "ColorBurn",
842   "Darken",      "Lighten",     "Difference",  "Exclusion",
843   "Hue",         "Saturation",   "Color",       "Luminosity",
844   "Compatible",
845 }
846
847 local function update_tr_res(res,mode,opaque)
848   local os = format("<</BM /%s/ca %.3f/CA %.3f/AIS false>>",mode,opaque,opaque)
849   local on, new = update_pdfobjs(os)
850   if new then
851     if pdfmode then
852       res = format("%s/MPLibTr%i %i 0 R",res,on,on)
853     else
854       if pgf.loaded then
855         texsprint(format("\csname %s\endcsname{/MPLibTr%i%s}", pgf.extgs, on, os))
856       else
857         texsprint(format("\special{pdf:put @MPLibTr<</MPLibTr%i%s>>}",on,os))
858       end
859     end
860   end
861   return res,on
862 end
863
864 local function tr_pdf_pageresources(mode,opaque)
865   if token and pgf.bye and not pgf.loaded then
866     pgf.loaded = token.create(pgf.bye).cmdname == "assign_toks"
867     pgf.bye = pgf.loaded and pgf.bye
868   end
869   local res, on_on, off_on = "", nil, nil
870   res, off_on = update_tr_res(res, "Normal", 1)
871   res, on_on = update_tr_res(res, mode, opaque)
872   if pdfmode then

```



```

873   if res ~= "" then
874     if pgf.loaded then
875       texsprint(format("\\csname %s\\endcsname{%s}", pgf.extgs, res))
876     else
877       local tpr, n = getpagers() or "", 0
878       tpr, n = tpr:gsub("/ExtGState<<", "%1"..res)
879       if n == 0 then
880         tpr = format("%s/ExtGState<<%s>>", tpr, res)
881       end
882       setpagers(tpr)
883     end
884   end
885 else
886   if not pgf.loaded then
887     texsprint(format("\\special{pdf:put @resources<</ExtGState @MPlibTr>>}"))
888   end
889 end
890 return on_on, off_on
891 end
892

```

Shading with metafun format. (maybe legacy way)

```

893 local shading_res
894
895 local function shading_initialize ()
896   shading_res = {}
897   if pdfmode and luatexbase.callbacktypes.finish_pdffile then -- ltluatex
898     local shading_obj = pdf.reserveobj()
899     setpagers(format("%s/Shading %i 0 R", getpagers() or "", shading_obj))
900     luatexbase.add_to_callback("finish_pdffile", function()
901       pdf.immediateobj(shading_obj, format("<<%s>>", tableconcat(shading_res)))
902     end, "luamplib.finish_pdffile")
903     pdf_objs.finishpdf = true
904   end
905 end
906
907 local function sh_pdfpageresources(shtype, domain, colorspace, colora, colorb, coordinates)
908   if not shading_res then shading_initialize() end
909   local os = format("<</FunctionType 2/Domain [ %s ]/C0 [ %s ]/C1 [ %s ]/N 1>>",
910     domain, colora, colorb)
911   local funcobj = pdfmode and format("%i 0 R", update_pdfobjs(os)) or os
912   os = format("<</ShadingType %i/ColorSpace %s/Function %s/Coords [ %s ]/Extend [ true true ]/AntiAlias true>>",
913     shtype, colorspace, funcobj, coordinates)
914   local on, new = update_pdfobjs(os)
915   if pdfmode then
916     if new then
917       local res = format("/MPlibSh%i %i 0 R", on, on)
918       if pdf_objs.finishpdf then
919         shading_res[#shading_res+1] = res
920       else

```

```

921     local pageres = getpageres() or ""
922     if not pageres:find("/Shading<<.*>>") then
923         pageres = pageres.."/Shading<<>>"
924     end
925     pageres = pageres:gsub("/Shading<<","%1"..res)
926     setpageres(pageres)
927 end
928 end
929 else
930     if new then
931         texsprint(format("\\special{pdf:put @MplibSh<</MplibSh%i%>>}",on,os))
932     end
933     texsprint(format("\\special{pdf:put @resources<</Shading @MplibSh>>}"))
934 end
935 return on
936 end
937
938 local function color_normalize(ca,cb)
939     if #cb == 1 then
940         if #ca == 4 then
941             cb[1], cb[2], cb[3], cb[4] = 0, 0, 0, 1-cb[1]
942         else -- #ca = 3
943             cb[1], cb[2], cb[3] = cb[1], cb[1], cb[1]
944         end
945     elseif #cb == 3 then -- #ca == 4
946         cb[1], cb[2], cb[3], cb[4] = 1-cb[1], 1-cb[2], 1-cb[3], 0
947     end
948 end
949
950 local prev_override_color
951
952 local function do_preobj_color(object,prescript)
953     transparency
954     local opaq = prescript and prescript.tr_transparency
955     local tron_no, troff_no
956     if opaq then
957         local mode = prescript.tr_alternative or 1
958         mode = transparency_modes[tonumber(mode)]
959         tron_no, troff_no = tr_pdf_pageresources(mode,opaq)
960         pdf_literalcode("/MplibTr%i gs",tron_no)
961     end
962     color
963     local override = prescript and prescript.MplibOverrideColor
964     if override then
965         if pdfmode then
966             pdf_literalcode(override)
967             override = nil
968         else
969             texsprint(format("\\special{color push %s}",override))
970         end
971     end
972 end

```

```

968     prev_override_color = override
969 end
970 else
971     local cs = object.color
972     if cs and #cs > 0 then
973         pdf_literalcode(luamplib.colorconverter(cs))
974         prev_override_color = nil
975     elseif not pdfmode then
976         override = prev_override_color
977         if override then
978             texsprint(format("\\special{color push %s}",override))
979         end
980     end
981 end

shading

982 local sh_type = prescript and prescript.sh_type
983 if sh_type then
984     local domain = prescript.sh_domain
985     local centera = prescript.sh_center_a:explode()
986     local centerb = prescript.sh_center_b:explode()
987     for _,t in pairs({centera,centerb}) do
988         for i,v in ipairs(t) do
989             t[i] = format("%f",v)
990         end
991     end
992     centera = tableconcat(centera," ")
993     centerb = tableconcat(centerb," ")
994     local colora = prescript.sh_color_a or {0};
995     local colorb = prescript.sh_color_b or {1};
996     for _,t in pairs({colora,colorb}) do
997         for i,v in ipairs(t) do
998             t[i] = format("%.3f",v)
999         end
1000     end
1001     if #colora > #colorb then
1002         color_normalize(colora,colorb)
1003     elseif #colorb > #colora then
1004         color_normalize(colorb,colora)
1005     end
1006     local colorspace
1007     if #colorb == 1 then colorspace = "DeviceGray"
1008     elseif #colorb == 3 then colorspace = "DeviceRGB"
1009     elseif #colorb == 4 then colorspace = "DeviceCMYK"
1010     else return troff_no,override
1011     end
1012     colora = tableconcat(colora, " ")
1013     colorb = tableconcat(colorb, " ")
1014     local shade_no
1015     if sh_type == "linear" then

```

```

1016     local coordinates = tableconcat({centera,centerb}," ")
1017     shade_no = sh_pdfpageresources(2,domain,colorspace,colora,colorb,coordinates)
1018     elseif sh_type == "circular" then
1019         local radiusa = format("%.f",prescript.sh_radius_a)
1020         local radiusb = format("%.f",prescript.sh_radius_b)
1021         local coordinates = tableconcat({centera,radiusa,centerb,radiusb}," ")
1022         shade_no = sh_pdfpageresources(3,domain,colorspace,colora,colorb,coordinates)
1023     end
1024     pdf_literalcode("q /Pattern cs")
1025     return troff_no,override,shade_no
1026 end
1027 return troff_no,override
1028 end
1029
1030 local function do_postobj_color(tr,over,sh)
1031     if sh then
1032         pdf_literalcode("W n /MPLibSh%s sh Q",sh)
1033     end
1034     if over then
1035         texsprint("\\special{color pop}")
1036     end
1037     if tr then
1038         pdf_literalcode("/MPLibTr%i gs",tr)
1039     end
1040 end
1041

```

Finally, flush figures by inserting PDF literals.

```

1042 local function flush(result,flusher)
1043     if result then
1044         local figures = result.fig
1045         if figures then
1046             for f=1, #figures do
1047                 info("flushing figure %s",f)
1048                 local figure = figures[f]
1049                 local objects = getobjects(result,figure,f)
1050                 local fignum = tonumber(figure:filename():match("([%d]+)$") or figure:charcode() or 0)
1051                 local miterlimit, linecap, linejoin, dashed = -1, -1, -1, false
1052                 local bbox = figure:boundingbox()
1053                 local llx, lly, urx, ury = bbox[1], bbox[2], bbox[3], bbox[4] -- faster than unpack
1054                 if urx < llx then

```

luamplib silently ignores this invalid figure for those that do not contain `beginfig ... endfig`.
(issue #70) Original code of ConTeXt general was:

```

-- invalid
pdf_startfigure(fignum,0,0,0,0)
pdf_stopfigure()

```

```

1055     else

```

For legacy behavior. Insert ‘pre-fig’ T_EX code here, and prepare a table for ‘in-fig’ codes.

```

1056     if tex_code_pre_mplib[f] then
1057         texsprint(tex_code_pre_mplib[f])
1058     end
1059     local TeX_code_bot = {}
1060     pdf_startfigure(fignum,llx,lly,urx,ury)
1061     start_pdf_code()
1062     if objects then
1063         local savedpath = nil
1064         local savedhtap = nil
1065         for o=1,#objects do
1066             local object      = objects[o]
1067             local objecttype   = object.type

```

The following 5 lines are part of btex...etex patch. Again, colors are processed at this stage.

```

1068         local prescript      = object.prescript
1069         prescript = prescript and script2table(prescript) -- prescript is now a table
1070         local tr_opaq,cr_over,shade_no = do_preobj_color(object,prescript)
1071         if prescript and prescript.mplibtexboxid then
1072             put_tex_boxes(object,prescript)
1073         elseif objecttype == "start_bounds" or objecttype == "stop_bounds" then --skip
1074         elseif objecttype == "start_clip" then
1075             local evenodd = not object.istext and object.postscript == "evenodd"
1076             start_pdf_code()
1077             flushnormalpath(object.path,false)
1078             pdf_literalcode(evenodd and "W* n" or "W n")
1079         elseif objecttype == "stop_clip" then
1080             stop_pdf_code()
1081             miterlimit, linecap, linejoin, dashed = -1, -1, -1, false
1082         elseif objecttype == "special" then

```

Collect T_EX codes that will be executed after flushing. Legacy behavior.

```

1083         if prescript and prescript.postmplibverbtex then
1084             TeX_code_bot[#TeX_code_bot+1] = prescript.postmplibverbtex
1085         end
1086         elseif objecttype == "text" then
1087             local ot = object.transform -- 3,4,5,6,1,2
1088             start_pdf_code()
1089             pdf_literalcode("%f %f %f %f %f %f cm",ot[3],ot[4],ot[5],ot[6],ot[1],ot[2])
1090             pdf_textfigure(object.font,object.dsize,object.text,object.width,object.height,object.depth)
1091             stop_pdf_code()
1092         else
1093             local evenodd, collect, both = false, false, false
1094             local postscript = object.postscript
1095             if not object.istext then
1096                 if postscript == "evenodd" then
1097                     evenodd = true
1098                 elseif postscript == "collect" then

```

```

1099         collect = true
1100     elseif postscript == "both" then
1101         both = true
1102     elseif postscript == "eoboth" then
1103         evenodd = true
1104         both = true
1105     end
1106 end
1107 if collect then
1108     if not savedpath then
1109         savedpath = { object.path or false }
1110         savedhtap = { object.htap or false }
1111     else
1112         savedpath[#savedpath+1] = object.path or false
1113         savedhtap[#savedhtap+1] = object.htap or false
1114     end
1115 else
1116     local ml = object.miterlimit
1117     if ml and ml ~= miterlimit then
1118         miterlimit = ml
1119         pdf_literalcode("%f M",ml)
1120     end
1121     local lj = object.linejoin
1122     if lj and lj ~= linejoin then
1123         linejoin = lj
1124         pdf_literalcode("%i j",lj)
1125     end
1126     local lc = object.linecap
1127     if lc and lc ~= linecap then
1128         linecap = lc
1129         pdf_literalcode("%i J",lc)
1130     end
1131     local dl = object.dash
1132     if dl then
1133         local d = format("[%s] %f d",tableconcat(dl.dashes or {}, " "),dl.offset)
1134         if d ~= dashed then
1135             dashed = d
1136             pdf_literalcode(dashed)
1137         end
1138     elseif dashed then
1139         pdf_literalcode("[ ] 0 d")
1140         dashed = false
1141     end
1142     local path = object.path
1143     local transformed, penwidth = false, 1
1144     local open = path and path[1].left_type and path[#path].right_type
1145     local pen = object.pen
1146     if pen then
1147         if pen.type == 'elliptical' then
1148             transformed, penwidth = pen_characteristics(object) -- boolean, value

```

```

1149         pdf_literalcode("%f w",penwidth)
1150         if objecttype == 'fill' then
1151             objecttype = 'both'
1152         end
1153         else -- calculated by mplib itself
1154             objecttype = 'fill'
1155         end
1156     end
1157     if transformed then
1158         start_pdf_code()
1159     end
1160     if path then
1161         if savedpath then
1162             for i=1,#savedpath do
1163                 local path = savedpath[i]
1164                 if transformed then
1165                     flushconcatpath(path,open)
1166                 else
1167                     flushnormalpath(path,open)
1168                 end
1169             end
1170             savedpath = nil
1171         end
1172         if transformed then
1173             flushconcatpath(path,open)
1174         else
1175             flushnormalpath(path,open)
1176         end
1177     end

```

Change from ConTeXt general: there was color stuffs.

```

1177         if not shade_no then -- conflict with shading
1178             if objecttype == "fill" then
1179                 pdf_literalcode(evenodd and "h f*" or "h f")
1180             elseif objecttype == "outline" then
1181                 if both then
1182                     pdf_literalcode(evenodd and "h B*" or "h B")
1183                 else
1184                     pdf_literalcode(open and "S" or "h S")
1185                 end
1186             elseif objecttype == "both" then
1187                 pdf_literalcode(evenodd and "h B*" or "h B")
1188             end
1189         end
1190     end
1191     if transformed then
1192         stop_pdf_code()
1193     end
1194     local path = object.htap
1195     if path then
1196         if transformed then

```

```

1197         start_pdf_code()
1198     end
1199     if savedhtap then
1200         for i=1,#savedhtap do
1201             local path = savedhtap[i]
1202             if transformed then
1203                 flushconcatpath(path,open)
1204             else
1205                 flushnormalpath(path,open)
1206             end
1207         end
1208         savedhtap = nil
1209         evenodd = true
1210     end
1211     if transformed then
1212         flushconcatpath(path,open)
1213     else
1214         flushnormalpath(path,open)
1215     end
1216     if objecttype == "fill" then
1217         pdf_literalcode(evenodd and "h f*" or "h f")
1218     elseif objecttype == "outline" then
1219         pdf_literalcode(open and "S" or "h S")
1220     elseif objecttype == "both" then
1221         pdf_literalcode(evenodd and "h B*" or "h B")
1222     end
1223     if transformed then
1224         stop_pdf_code()
1225     end
1226 end
1227 end
1228 end

```

Added to ConTeXt general: color stuff. And execute legacy verbatimex code.

```

1229         do_postobj_color(tr_opaq,cr_over,shade_no)
1230     end
1231 end
1232 stop_pdf_code()
1233 pdf_stopfigure()
1234 if #TeX_code_bot > 0 then texsprint(TeX_code_bot) end
1235 end
1236 end
1237 end
1238 end
1239 end
1240 luamplib.flush = flush
1241
1242 local function colorconverter(cr)
1243     local n = #cr
1244     if n == 4 then

```



```

1245     local c, m, y, k = cr[1], cr[2], cr[3], cr[4]
1246     return format("%.3f %.3f %.3f %.3f k %.3f %.3f %.3f %.3f K",c,m,y,k,c,m,y,k), "0 g 0 G"
1247 elseif n == 3 then
1248     local r, g, b = cr[1], cr[2], cr[3]
1249     return format("%.3f %.3f %.3f rg %.3f %.3f %.3f RG",r,g,b,r,g,b), "0 g 0 G"
1250 else
1251     local s = cr[1]
1252     return format("%.3f g %.3f G",s,s), "0 g 0 G"
1253 end
1254 end
1255 luamplib.colorconverter = colorconverter

```

2.2 T_EX package

First we need to load some packages.

```

1256 \bgroup\expandafter\expandafter\expandafter\egroup
1257 \expandafter\ifx\csname selectfont\endcsname\relax
1258   \input ltluatex
1259 \else
1260   \NeedsTeXFormat{LaTeX2e}
1261   \ProvidesPackage{luamplib}
1262     [2019/10/11 v2.20.2 mplib package for LuaTeX]
1263   \ifx\newluafunction\undefined
1264     \input ltluatex
1265   \fi
1266 \fi

```

Loading of lua code.

```

1267 \directlua{require("luamplib")}

```

Support older engine. Seems we don't need it, but no harm.

```

1268 \ifx\scantextokens\undefined
1269   \let\scantextokens\luatexscantextokens
1270 \fi
1271 \ifx\pdfoutput\undefined
1272   \let\pdfoutput\outputmode
1273   \protected\def\pdfliteral{\pdfextension literal}
1274 \fi

```

Set the format for metapost.

```

1275 \def\mplibsetformat#1{\directlua{luamplib.setformat("#1")}}

```

luamplib works in both PDF and DVI mode, but only DVIPDFMx is supported currently among a number of DVI tools. So we output a warning.

```

1276 \ifnum\pdfoutput>0
1277   \let\mplibtoPDF\pdfliteral
1278 \else
1279   \def\mplibtoPDF#1{\special{pdf:literal direct #1}}
1280   \ifcsname PackageWarning\endcsname
1281     \PackageWarning{luamplib}{take dvipdfmx path, no support for other dvi tools currently.}

```

```

1282 \else
1283   \write128{}
1284   \write128{luamplib Warning: take dvipdfmx path, no support for other dvi tools currently.}
1285   \write128{}
1286 \fi
1287 \fi

    Make mplibcode typesetted always in horizontal mode.
1288 \def\mplibforcehmode{\let\mplibhmodeornot\leavevmode}
1289 \def\mplibnoforcehmode{\let\mplibhmodeornot\relax}
1290 \mplibnoforcehmode

    Catcode. We want to allow comment sign in mplibcode.
1291 \def\mplibsetupcatcodes{%
1292   \mplibhmodeornot %catcode'\={12 %catcode'\}=12
1293   \catcode'\#=12 \catcode'\^=12 \catcode'\~=12 \catcode'\_ =12
1294   \catcode'\&=12 \catcode'\$=12 \catcode'\%=12 \catcode'\^M=12 \endlinechar=10
1295 }

    Make btex...etex box zero-metric.
1296 \def\mplibputtextbox#1{\vbox to 0pt{\vss\hbox to 0pt{\raise\dp#1\copy#1\hss}}}

    As we have changed ^^J catcode, the last line containing \end{mplibcode} has \n at
    the end. Replace it with ^^M.
1297 \newcount\mplibstartlineno
1298 \def\mplibpostmpcatcodes{%
1299   \catcode'\{=12 \catcode'\}=12 \catcode'\#=12 \catcode'\%=12 }
1300 \def\mplibreplacelinebr{%
1301   \begingroup \mplibpostmpcatcodes \mplibdoreplacelinebr}
1302 \begingroup\lccode'\~='^^M \lowercase{\endgroup
1303   \def\mplibdoreplacelinebr#1^^J{\endgroup\scantextokens{{}}#1~}}

    The Plain-specific stuff.
1304 \bgroup\expandafter\expandafter\expandafter\egroup
1305 \expandafter\ifx\csname selectfont\endcsname\relax
1306 \def\mplibreplacelinecs{%
1307   \begingroup \mplibpostmpcatcodes \mplibdoreplacelinecs}
1308 \begingroup\lccode'\~='^^M \lowercase{\endgroup
1309   \def\mplibdoreplacelinecs#1^^J{\endgroup\scantextokens{\relax#1~}}}
1310 \def\mplibcode{%
1311   \mplibstartlineno\inputlineno
1312   \begingroup
1313   \begingroup
1314   \mplibsetupcatcodes
1315   \mplibdocode
1316 }
1317 \long\def\mplibdocode#1\endmplibcode{%
1318   \endgroup
1319   \directlua{luamplib.process_mplibcode([===[\unexpanded{#1}]===])}%
1320   \endgroup
1321   \ifnum\mplibstartlineno<\inputlineno\expandafter\mplibreplacelinecs\fi
1322 }

```

```

1323 \else
      The LATEX-specific part: a new environment.
1324 \newenvironment{mplibcode}{%
1325   \global\mplibstartlineno\inputlineno
1326   \toks@{}\ltxdomplibcode
1327 }{}
1328 \def\ltxdomplibcode{%
1329   \begingroup
1330   \mplibsetupcatcodes
1331   \ltxdomplibcodeindeed
1332 }
1333 \def\mplib@mplibcode{mplibcode}
1334 \long\def\ltxdomplibcodeindeed#1\end#2{%
1335   \endgroup
1336   \toks@\expandafter{\the\toks@#1}%
1337   \def\mplibtemp@a{#2}%
1338   \ifx\mplib@mplibcode\mplibtemp@a
1339     \directlua{luamplib.process_mplibcode([==[\the\toks@]==])}%
1340     \end{mplibcode}%
1341     \ifnum\mplibstartlineno<\inputlineno
1342       \expandafter\expandafter\expandafter\mplibreplacenewlinebr
1343       \fi
1344   \else
1345     \toks@\expandafter{\the\toks@\end{#2}}\expandafter\ltxdomplibcode
1346   \fi
1347 }
1348 \fi

      User settings.
1349 \def\mpliblegacybehavior#1{\directlua{
1350   local s = string.lower("#1")
1351   if s == "enable" or s == "true" or s == "yes" then
1352     luamplib.legacy_verbatimtex = true
1353   else
1354     luamplib.legacy_verbatimtex = false
1355   end
1356 }}
1357 \def\mplibverbatim#1{\directlua{
1358   local s = string.lower("#1")
1359   if s == "enable" or s == "true" or s == "yes" then
1360     luamplib.verbatiminput = true
1361   else
1362     luamplib.verbatiminput = false
1363   end
1364 }}
1365 \newtoks\mplibtmptoks

      \everymplib & \everyendmplib: macros redefining \everymplibtoks & \everyendmplibtoks
      respectively
1366 \newtoks\everymplibtoks

```

```

1367 \newtoks\everyendmplibtoks
1368 \protected\def\everymplib{%
1369   \mplibstartlineno\inputlineno
1370   \begingroup
1371   \mplibsetupcatcodes
1372   \mplibdoeverymplib
1373 }
1374 \long\def\mplibdoeverymplib#1{%
1375   \endgroup
1376   \everymplibtoks{#1}%
1377   \ifnum\mplibstartlineno<\inputlineno\expandafter\mplibreplacelinebr\fi
1378 }
1379 \protected\def\everyendmplib{%
1380   \mplibstartlineno\inputlineno
1381   \begingroup
1382   \mplibsetupcatcodes
1383   \mplibdoeveryendmplib
1384 }
1385 \long\def\mplibdoeveryendmplib#1{%
1386   \endgroup
1387   \everyendmplibtoks{#1}%
1388   \ifnum\mplibstartlineno<\inputlineno\expandafter\mplibreplacelinebr\fi
1389 }

```

Allow \TeX dimen macros in mplibcode. But now runsript does the job.

```
\def\mpdim#1{ \begingroup \the\dimexpr #1\relax\space \endgroup }% gmp.sty
```

MPLib's number system. Now binary has gone away.

```

1390 \def\mplibnumbersystem#1{\directlua{
1391   local t = "#1"
1392   if t == "binary" then t = "decimal" end
1393   luamplib.numbersystem = t
1394 }}

```

Settings for .mp cache files.

```

1395 \def\mplibmakenocache#1{\mplibdomakenocache #1,*}
1396 \def\mplibdomakenocache#1,{%
1397   \ifx\empty#1\empty
1398     \expandafter\mplibdomakenocache
1399   \else
1400     \ifx*#1\else
1401       \directlua{luamplib.noneedtoreplace["#1.mp"]=true}%
1402       \expandafter\expandafter\expandafter\mplibdomakenocache
1403     \fi
1404   \fi
1405 }
1406 \def\mplibcancelnocache#1{\mplibdocancelnocache #1,*}
1407 \def\mplibdocancelnocache#1,{%
1408   \ifx\empty#1\empty

```

```

1409 \expandafter\mplibdocancelnocache
1410 \else
1411 \ifx*#1\else
1412 \directlua{luamplib.noneedtoreplace["#1.mp"]=false}%
1413 \expandafter\expandafter\expandafter\mplibdocancelnocache
1414 \fi
1415 \fi
1416 }
1417 \def\mplibcachedir#1{\directlua{luamplib.getcachedir("\unexpanded{#1}")}}

```

More user settings.

```

1418 \def\mplibtexttextlabel#1{\directlua{
1419   local s = string.lower("#1")
1420   if s == "enable" or s == "true" or s == "yes" then
1421     luamplib.texttextlabel = true
1422   else
1423     luamplib.texttextlabel = false
1424   end
1425 }}
1426 \def\mplibcodeinherit#1{\directlua{
1427   local s = string.lower("#1")
1428   if s == "enable" or s == "true" or s == "yes" then
1429     luamplib.codeinherit = true
1430   else
1431     luamplib.codeinherit = false
1432   end
1433 }}
1434 \def\mplibglobaltexttext#1{\directlua{
1435   local s = string.lower("#1")
1436   if s == "enable" or s == "true" or s == "yes" then
1437     luamplib.globaltexttext = true
1438   else
1439     luamplib.globaltexttext = false
1440   end
1441 }}

```

The followings are from ConTeXt general, mostly. We use a dedicated scratchbox.

```

1442 \ifx\mplibscratchbox\undefined \newbox\mplibscratchbox \fi

```

We encapsulate the literals.

```

1443 \def\mplibstarttoPDF#1#2#3#4{%
1444   \hbox\bgroup
1445   \xdef\MPllx{#1}\xdef\MPlly{#2}%
1446   \xdef\MPurx{#3}\xdef\MPury{#4}%
1447   \xdef\MPwidth{\the\dimexpr#3bp-#1bp\relax}%
1448   \xdef\MPheight{\the\dimexpr#4bp-#2bp\relax}%
1449   \parskip0pt%
1450   \leftskip0pt%
1451   \parindent0pt%
1452   \everypar{}%
1453   \setbox\mplibscratchbox\vbox\bgroup

```

```

1454 \noindent
1455 }
1456 \def\mplibstoptoPDF{%
1457 \egroup %
1458 \setbox\mplibscratchbox\hbox %
1459 {\hskip-\MPllx bp%
1460 \raise-\MPlly bp%
1461 \box\mplibscratchbox}%
1462 \setbox\mplibscratchbox\vbox to \MPheight
1463 {\vfill
1464 \hsize\MPwidth
1465 \wd\mplibscratchbox0pt%
1466 \ht\mplibscratchbox0pt%
1467 \dp\mplibscratchbox0pt%
1468 \box\mplibscratchbox}%
1469 \wd\mplibscratchbox\MPwidth
1470 \ht\mplibscratchbox\MPheight
1471 \box\mplibscratchbox
1472 \egroup
1473 }

```

Text items have a special handler.

```

1474 \def\mplibtexttext#1#2#3#4#5{%
1475 \beginingroup
1476 \setbox\mplibscratchbox\hbox
1477 {\font\temp=#1 at #2bp%
1478 \temp
1479 #3}%
1480 \setbox\mplibscratchbox\hbox
1481 {\hskip#4 bp%
1482 \raise#5 bp%
1483 \box\mplibscratchbox}%
1484 \wd\mplibscratchbox0pt%
1485 \ht\mplibscratchbox0pt%
1486 \dp\mplibscratchbox0pt%
1487 \box\mplibscratchbox
1488 \endgroup
1489 }

```

Input luamplib.cfg when it exists.

```

1490 \openin0=luamplib.cfg
1491 \ifeof0 \else
1492 \closein0
1493 \input luamplib.cfg
1494 \fi

```

That's all folks!

3 The GNU GPL License v2

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