The luamplib package

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Abstract

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

1 Documentation

This packages 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.

The package needs to be in PDF mode in order to output something, as PDF specials are not supported by the DVI format and tools.

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

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

- a LATEX environment
- all TEX macros start by `mplib`
- use of luatexbase for errors, warnings and declaration
- possibility to use `btex ... etex` to typeset TEX code. `textext()` is a more versatile macro equivalent to `TEX()` from TEX.mp. `TEX()` is also allowed unless TEX.mp is loaded, which should be always avoided.
- `verbatimtex ... etex` that comes just before `beginfig()` is not ignored, but the TEX code inbetween will be inserted before the following mplib hbox. Using this command, each mplib box can be freely moved horizontally and/or vertically. All other `verbatimtex ... etex`'s are ignored. *E.G.*:

```
\mplibcode
verbatimtex \moveright 3cm etex; beignfig(0); ... endfig;
verbatimtex \leavevmode etex; beignfig(1); ... endfig;
```

```
verbatimtex \leavevmode\lower 1ex etex; beignfig(2); ... endfig;
verbatimtex \endgraf\moveright 1cm etex; beignfig(3); ... endfig;
\endmplibcode
```

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

- Notice that, after each figure is processed, macro `\MPwidth` stores the width value of latest figure; `\MPheight`, the height value.

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

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

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

```
luamplib          = luamplib or { }
```

Identification.

```
local luamplib    = luamplib
luamplib.showlog  = luamplib.showlog or false
luamplib.lastlog  = ""

local err, warn, info, log = luatexbase.provides_module({
    name          = "luamplib",
    version       =  2.2,
    date          = "2013/12/29",
    description   = "Lua package to typeset Metapost with LuaTeX's MPLib.",
})
```

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

```
local format, abs = string.format, math.abs

local stringgsub    = string.gsub
local stringfind    = string.find
```

```
local stringmatch   = string.match
local stringgmatch  = string.gmatch
local tableconcat   = table.concat
local texsprint     = tex.sprint

local mplib = require ('mplib')
local kpse  = require ('kpse')

local file = file
if not file then

```

This is a small trick for LaTeX. In LaTeX we read the metapost code line by line, but it needs to be passed entirely to `process()`, so we simply add the lines in `data` and at the end we call `process(data)`.

A few helpers, taken from `l-file.lua`.

```

  file = { }

  function file.replacesuffix(filename, suffix)
      return (stringgsub(filename,"%.[%a%d]+$","")) .. "." .. suffix
  end

  function file.stripsuffix(filename)
      return (stringgsub(filename,"%.[%a%d]+$",""))
  end
end
```

As the finder function for `mplib`, use the `kpse` library and make it behave like as if MetaPost was used (or almost, since the engine name is not set this way—not sure if this is a problem).

```

local mpkpse = kpse.new("luatex", "mpost")

local function finder(name, mode, ftype)
    if mode == "w" then
        return name
    else
        return mpkpse:find_file(name,ftype)
    end
end
luamplib.finder = finder

```

The rest of this module is not documented. More info can be found in the LuaTeX manual, articles in user group journals and the files that ship with ConTeXt.

```

function luamplib.resetlastlog()
    luamplib.lastlog = ""
```

```
end

```

Below included is section that defines fallbacks for older versions of mplib.

```
local mplibone = tonumber(mplib.version()) <= 1.50

if mplibone then

    luamplib.make = luamplib.make or function(name,mem_name,dump)
        local t = os.clock()
        local mpx = mplib.new {
            ini_version = true,
            find_file = luamplib.finder,
            job_name = file.stripsuffix(name)
        }
        mpx:execute(format("input %s ;",name))
        if dump then
            mpx:execute("dump ;")
            info("format %s made and dumped for %s in %0.3f seconds",mem_name,name,os.clock()-t)
        else
            info("%s read in %0.3f seconds",name,os.clock()-t)
        end
        return mpx
    end

    function luamplib.load(name)
        local mem_name = file.replacesuffix(name,"mem")
        local mpx = mplib.new {
            ini_version = false,
            mem_name = mem_name,
            find_file = luamplib.finder
        }
        if not mpx and type(luamplib.make) == "function" then
            -- when i have time i'll locate the format and dump
            mpx = luamplib.make(name,mem_name)
        end
        if mpx then
            info("using format %s",mem_name,false)
            return mpx, nil
        else
            return nil, { status = 99, error = "out of memory or invalid format" }
        end
    end

else

```

These are the versions called with sufficiently recent mplib.

```

    local preamble = [[
```

```
        boolean mplib ; mplib := true ;
        let dump = endinput ;
        let normalfontsize = fontsize;
        input %s ;
    ]]

    luamplib.make = luamplib.make or function()
    end

    function luamplib.load(name)
        local mpx = mplib.new {
            ini_version = true,
            find_file = luamplib.finder,
        }
        local result
        if not mpx then
            result = { status = 99, error = "out of memory"}
        else
            result = mpx:execute(format(preamble, file.replacesuffix(name,"mp")))
        end
        luamplib.reporterror(result)
        return mpx, result
    end

end

local currentformat = "plain"

local function setformat (name) --- used in .sty
    currentformat = name
end
luamplib.setformat = setformat


luamplib.reporterror = function (result)
    if not result then
        err("no result object returned")
    elseif result.status > 0 then
        local t, e, l = result.term, result.error, result.log
        if t then
            info(t)
        end
        if e then
            err(e)
        end
        if not t and not e and l then
            luamplib.lastlog = luamplib.lastlog .. "\n " .. l
            log(l)
        else
            err("unknown, no error, terminal or log messages")
```

```
        end
    else
        return false
    end
    return true
end

local function process_indeed (mpx, data)
    local converted, result = false, {}
    local mpx = luamplib.load(mpx)
    if mpx and data then
        local result = mpx:execute(data)
        if not result then
            err("no result object returned")
        elseif result.status > 0 then
            err("%s",(result.term or "no-term") .. "\n" .. (result.error or "no-error"))
        elseif luamplib.showlog then
            luamplib.lastlog = luamplib.lastlog .. "\n" .. result.term
            info("%s",result.term or "no-term")
        elseif result.fig then
            converted = luamplib.convert(result)
        else
            err("unknown error, maybe no beginfig/endfig")
        end
    else
        err("Mem file unloadable. Maybe generated with a different version of mplib?")
    end
    return converted, result
end
local process = function (data)
    return process_indeed(currentformat, data)
end
luamplib.process = process

local function getobjects(result,figure,f)
    return figure:objects()
end

local function convert(result, flusher)
    luamplib.flush(result, flusher)
    return true -- done
end
luamplib.convert = convert

local function pdf_startfigure(n,llx,lly,urx,ury)
```

The following line has been slightly modified by Kim.

```
    texsprint(format("\\mplibstarttoPDF{%f}{%f}{%f}{%f}",llx,lly,urx,ury))
end

```

```
local function pdf_stopfigure()
    texsprint("\\mplibstoptoPDF")
end

local function pdf_literalcode(fmt,...) -- table
    texsprint(format("\\mplibtoPDF{%s}",format(fmt,...)))
end
luamplib.pdf_literalcode = pdf_literalcode

local function pdf_textfigure(font,size,text,width,height,depth)
```

The following three lines have been modified by Kim.

```
    -- if text == "" then text = "\0" end -- char(0) has gone
    text = text:gsub(".",function(c)
        return format("\\hbox{\\char%i}",string.byte(c)) -- kerning happens in meta-
post
    end)
    texsprint(format("\\mplibtextext{%s}{%f}{%s}{%s}{%f}",font,size,text,0,-( 7200/ 7227)/65536*depth)
end
luamplib.pdf_textfigure = pdf_textfigure

local bend_tolerance = 131/65536

local rx, sx, sy, ry, tx, ty, divider = 1, 0, 0, 1, 0, 0, 1

local function pen_characteristics(object)
    local t = mplib.pen_info(object)
    rx, ry, sx, sy, tx, ty = t.rx, t.ry, t.sx, t.sy, t.tx, t.ty
    divider = sx*sy - rx*ry
    return not (sx==1 and rx==0 and ry==0 and sy==1 and tx==0 and ty==0), t.width
end

local function concat(px, py) -- no tx, ty here
    return (sy*px-ry*py)/divider,(sx*py-rx*px)/divider
end

local function curved(ith,pth)
    local d = pth.left_x - ith.right_x
    if abs(ith.right_x - ith.x_coord - d) <= bend_tolerance and abs(pth.x_coord - pth.left_x - d) <= be
erance then
        d = pth.left_y - ith.right_y
        if abs(ith.right_y - ith.y_coord - d) <= bend_tolerance and abs(pth.y_co-
ord - pth.left_y - d) <= bend_tolerance then
            return false
        end
    end
    return true
end

local function flushnormalpath(path,open)
```

```
    local pth, ith
    for i=1,#path do
        pth = path[i]
        if not ith then
            pdf_literalcode("%f %f m",pth.x_coord,pth.y_coord)
        elseif curved(ith,pth) then
            pdf_literalcode("%f %f %f %f %f %f c",ith.right_x,ith.right_y,pth.left_x,pth.left_y,pth.x_c
        else
            pdf_literalcode("%f %f l",pth.x_coord,pth.y_coord)
        end
        ith = pth
    end
    if not open then
        local one = path[1]
        if curved(pth,one) then
            pdf_literalcode("%f %f %f %f %f %f c",pth.right_x,pth.right_y,one.left_x,one.left_y,one.x_c
        else
            pdf_literalcode("%f %f l",one.x_coord,one.y_coord)
        end
    elseif #path == 1 then
        -- special case .. draw point
        local one = path[1]
        pdf_literalcode("%f %f l",one.x_coord,one.y_coord)
    end
    return t
end

local function flushconcatpath(path,open)
    pdf_literalcode("%f %f %f %f %f %f cm", sx, rx, ry, sy, tx ,ty)
    local pth, ith
    for i=1,#path do
        pth = path[i]
        if not ith then
           pdf_literalcode("%f %f m",concat(pth.x_coord,pth.y_coord))
        elseif curved(ith,pth) then
            local a, b = concat(ith.right_x,ith.right_y)
            local c, d = concat(pth.left_x,pth.left_y)
            pdf_literalcode("%f %f %f %f %f %f c",a,b,c,d,concat(pth.x_coord, pth.y_co-
ord))
        else
           pdf_literalcode("%f %f l",concat(pth.x_coord, pth.y_coord))
        end
        ith = pth
    end
    if not open then
        local one = path[1]
        if curved(pth,one) then
            local a, b = concat(pth.right_x,pth.right_y)
            local c, d = concat(one.left_x,one.left_y)
```

```
            pdf_literalcode("%f %f %f %f %f %f c",a,b,c,d,concat(one.x_coord, one.y_coord))
        else
            pdf_literalcode("%f %f l",concat(one.x_coord,one.y_coord))
        end
    elseif #path == 1 then
        -- special case .. draw point
        local one = path[1]
        pdf_literalcode("%f %f l",concat(one.x_coord,one.y_coord))
    end
    return t
end

```

Below code has been contributed by Dohyun Kim. It implements `btex` / `etex` functions.

v2.1: `textext()` is now available, which is equivalent to `TEX()` macro from TEX.mp. `TEX()` is synonym of `textext()` unless TEX.mp is loaded.

v2.2: Transparency and Shading

```
local further_split_keys = {
    ["MPlibTEXboxID"] = true,
    ["sh_color_a"]    = true,
    ["sh_color_b"]    = true,
}

local function script2table(s)
    local t = {}
    for i in stringgmatch(s,"[^\13]+") do
        local k,v = stringmatch(i,"(.-)=(.+)") -- v may contain =.
        if k and v then
            local vv = {}
            if further_split_keys[k] then
                for j in stringgmatch(v,"[^:]+") do
                    vv[#vv+1] = j
                end
            end
            if #vv > 0 then
                t[k] = vv
            else
                t[k] = v
            end
        end
    end
    return t
end

local mplibcodepreamble = [[
vardef rawtextext (expr t) =
    if unknown TEXBOX_:
        image( special "MPlibmkTEXbox="&t; )
    else:
```

```
        TEXBOX_ := TEXBOX_ + 1;
        image (
            addto currentpicture doublepath unitsquare
            xscaled TEXBOX_wd[TEXBOX_]
            yscaled (TEXBOX_ht[TEXBOX_] + TEXBOX_dp[TEXBOX_])
            shifted (0, -TEXBOX_dp[TEXBOX_])
            withprescript "MPlibTEXboxID=" &
                          decimal TEXBOX_ & ":" &
                          decimal TEXBOX_wd[TEXBOX_] & ":" &
                          decimal(TEXBOX_ht[TEXBOX_]+TEXBOX_dp[TEXBOX_]);
        )
    fi
enddef;
if known context_mlib:
    defaultfont := "cmtt10";
    let infont = normalinfont;
    let fontsize = normalfontsize;
    vardef thelabel@#(expr p,z) =
        if string p :
            thelabel@#(p infont defaultfont scaled defaultscale,z)
        else :
            p shifted (z + labeloffset*mfun_laboff@# -
                (mfun_labxf@#*lrcorner p + mfun_labyf@#*ulcorner p +
                (1-mfun_labxf@#-mfun_labyf@#)*llcorner p))
        fi
    enddef;
else:
    vardef textext@# (text t) = rawtextext (t) enddef;
fi
def externalfigure primary filename =
    draw rawtextext("\includegraphics{"& filename &"}")
enddef;
def TEX = textext enddef;
def fontmapfile primary filename = enddef;
def specialVerbatimTeX (text t) = special "MPlibVerbTeX="&t; enddef;
def ignoreVerbatimTeX  (text t) = enddef;
let VerbatimTeX = specialVerbatimTeX;
extra_beginfig := extra_beginfig & " let VerbatimTeX = ignoreVerbatimTeX;" ;
extra_endfig   := extra_endfig   & " let VerbatimTeX = specialVerbatimTeX;" ;
]]

local factor = 65536*(7227/7200)

local function putTEXboxes (object,prescript)
    local box = prescript.MPlibTEXboxID
    local n,tw,th = box[1],box[2],box[3]
    if n and tw and th then
        local op = object.path
        local first, second, fourth = op[1], op[2], op[4]
        local tx, ty = first.x_coord, first.y_coord
```

```
        local sx, sy = (second.x_coord - tx)/tw, (fourth.y_coord - ty)/th
        local rx, ry = (second.y_coord - ty)/tw, (fourth.x_coord - tx)/th
        if sx == 0 then sx = 0.00001 end
        if sy == 0 then sy = 0.00001 end
        pdf_literalcode("q %f %f %f %f %f %f cm",sx,rx,ry,sy,tx,ty)
        texsprint(format("\\mplibputtextbox{%i}",n))
        pdf_literalcode("Q")
    end
end

local TeX_code_t = {}

local function domakeTEXboxes (data)
    local num = tex.count[14] -- newbox register
    if data and data.fig then
        local figures = data.fig
        for f=1, #figures do
            TeX_code_t[f] = nil
            local figure = figures[f]
            local objects = getobjects(data,figure,f)
            if objects then
                for o=1,#objects do
                    local object    = objects[o]
                    local prescript = object.prescript
                    prescript = prescript and script2table(prescript)
                    local str = prescript and prescript.MPlibmkTEXbox
                    if str then
                        num = num + 1
                        texsprint(format("\\setbox%i\\hbox{%s}",num,str))
                    end
```

`verbatimtex ... etex` before `beginfig()` is not ignored, but the TEX code inbetween is inserted before the mplib box.

```
                    local texcode = prescript and prescript.MPlibVerbTeX
                    if texcode and texcode ~= "" then
                        TeX_code_t[f] = texcode
                    end
                end
            end
        end
    end
end

local function makeTEXboxes (data)
    data = "relax " .. data
    data = stringgsub(data, "([^A-Z_a-z])btex([^A-Z_a-z])",
    function(pre,post)
        post = stringgsub(post,"%s","")
        return pre .. 'rawtextext("' .. post
    end)
```

```
    data = stringgsub(data, ”([^A-Z_a-z])verbatimtex([^A-Z_a-z])”,
    function(pre,post)
        post = stringgsub(post,”%s”,””)
        return pre .. ’VerbatimTeX(”’ .. post
    end)
    data = stringgsub(data, ”([^A-Z_a-z])etex([^A-Z_a-z])”,
    function(pre,post)
        pre = stringgsub(pre,”%s”,””)
        return pre .. ’”)’ .. post
    end)
    local mpx = luamplib.load(currentformat)
    if mpx and data then
        local result = mpx:execute(mplibcodepreamble .. data)
        domakeTEXboxes(result)
    end
    return data
end

luamplib.makeTEXboxes = makeTEXboxes

local function processwithTEXboxes (data)
    local num = tex.count[14] -- the same newbox register
    local prepreamble = ”TEXBOX_ := ”..num..”;\n”
    while true do
        num = num + 1
        local box = tex.box[num]
        if not box then break end
        prepreamble = prepreamble ..
        ”TEXBOX_wd[”..num..”] := ”..box.width /factor..”;\n”..
        ”TEXBOX_ht[”..num..”] := ”..box.height/factor..”;\n”..
        ”TEXBOX_dp[”..num..”] := ”..box.depth /factor..”;\n”
    end
    process(prepreamble .. mplibcodepreamble .. data)
end

luamplib.processwithTEXboxes = processwithTEXboxes
```

Transparency and Shading

```
local pdf_objs = {}

-- objstr <string> => obj <number>, new <boolean>
local function update_pdfobjs (os)
    local on = pdf_objs[os]
    if on then
        return on,false
    end
    on = pdf.immediateobj(os)
    pdf_objs[os] = on
    return on,true
```

```
485 end
486
487 local transparancy_modes = { [0] =  ”Normal”,
488     ”Normal”,       ”Multiply”,     ”Screen”,       ”Overlay”,
489     ”SoftLight”,    ”HardLight”,    ”ColorDodge”,   ”ColorBurn”,
490     ”Darken”,       ”Lighten”,      ”Difference”,   ”Exclusion”,
491     ”Hue”,          ”Saturation”,   ”Color”,        ”Luminosity”,
492     ”Compatible”,
493 }
494
495 local function update_tr_res(res,mode,opaq)
496     local os = format(”<</BM /%s/ca %g/CA %g/AIS false>>”,mode,opaq,opaq)
497     local on, new = update_pdfobjs(os)
498     if new then
499         res = res .. format(”/MPlibTr%s%g %i 0 R”,mode,opaq,on)
500     end
501     return res
502 end
503
504 local function tr_pdf_pageresources(mode,opaq)
505     local res = ””
506     res = update_tr_res(res, ”Normal”, 1)
507     res = update_tr_res(res, mode, opaq)
508     if res ~= ”” then
509         local tpr = tex.pdfpageresources -- respect luaotfload-colors
510         if not stringfind(tpr,”/ExtGState<<.*>>”) then
511             tpr = tpr..”/ExtGState<<>>”
512         end
513         tpr = stringgsub(tpr,”/ExtGState<<”,”%1”..res)
514         tex.set(”global”,”pdfpageresources”,tpr)
515     end
516 end
517
518 -- luatexbase.mcb is not yet updated: ”finish_pdffile” callback is missing
519
520 local function sh_pdfpageresources(shtype,domain,colorspace,colora,colorb,coordinates)
521     local os, on, new
522     os = format(”<</FunctionType 2/Domain [ %s ]/C0 [ %s ]/C1 [ %s ]/N 1>>”,
523                 domain, colora, colorb)
524     on = update_pdfobjs(os)
525     os = format(”<</ShadingType %i/ColorSpace /%s/Function %i 0 R/Coords [ %s ]/Ex-
   tend [ true true ]/AntiAlias true>>”,
526                 shtype, colorspace, on, coordinates)
527     on, new = update_pdfobjs(os)
528     if not new then
529         return on
530     end
531     local res = format(”/MPlibSh%i %i 0 R”, on, on)
532     local ppr = pdf.pageresources or ””
533     if not stringfind(ppr,”/Shading<<.*>>”) then
```

```
        ppr = ppr..”/Shading<<>>”
    end
    pdf.pageresources = stringgsub(ppr,”/Shading<<”,”%1”..res)
    return on
end

local function color_normalize(ca,cb)
    if #cb == 1 then
        if #ca == 4 then
            cb[1], cb[2], cb[3], cb[4] = 0, 0, 0, 1-cb[1]
        else -- #ca = 3
            cb[1], cb[2], cb[3] = cb[1], cb[1], cb[1]
        end
    elseif #cb == 3 then -- #ca == 4
        cb[1], cb[2], cb[3], cb[4] = 1-cb[1], 1-cb[2], 1-cb[3], 0
    end
end

local function do_preobj_color(object,prescript)
    -- transparency
    local opaq = prescript and prescript.tr_transparency
    if opaq then
        local mode = prescript.tr_alternative or 1
        mode = transparancy_modes[tonumber(mode)]
        tr_pdf_pageresources(mode,opaq)
        pdf_literalcode(”/MPlibTr%s%g gs”,mode,opaq)
    end
    -- color
    local cs = object.color
    if cs and #cs > 0 then
        pdf_literalcode(luamplib.colorconverter(cs))
    end
    -- shading
    local sh_type = prescript and prescript.sh_type
    if sh_type then
        local domain  = prescript.sh_domain
        local centera = prescript.sh_center_a
        local centerb = prescript.sh_center_b
        local colora  = prescript.sh_color_a or {0};
        local colorb  = prescript.sh_color_b or {1};
        if #colora > #colorb then
            color_normalize(colora,colorb)
        elseif #colorb > #colora then
            color_normalize(colorb,colora)
        end
        local colorspace
        if     #colorb == 1 then colorspace = ”DeviceGray”
        elseif #colorb == 3 then colorspace = ”DeviceRGB”
        elseif #colorb == 4 then colorspace = ”DeviceCMYK”
        else   return opaq
```

```
        end
        colora = tableconcat(colora, " ")
        colorb = tableconcat(colorb, " ")
        local shade_no
        if sh_type == "linear" then
            local coordinates = format("%s %s",centera,centerb)
            shade_no = sh_pdfpageresources(2,domain,colorspace,colora,colorb,coordinates)
        elseif sh_type == "circular" then
            local radiusa = prescript.sh_radius_a
            local radiusb = prescript.sh_radius_b
            local coordinates = format("%s %s %s %s",centera,radiusa,centerb,radiusb)
            shade_no = sh_pdfpageresources(3,domain,colorspace,colora,colorb,coordinates)
        end
        pdf_literalcode("q /Pattern cs")
        return opaq,shade_no
    end
    return opaq
end

local function do_postobj_color(tr,sh)
    if sh then
        pdf_literalcode("W n /MPlibSh%s sh Q",sh)
    end
    if tr then
        pdf_literalcode("/MPlibTrNormal1 gs")
    end
end

```

End of `btex` – `etex` and Transparency/Shading patch.

```

local function flush(result,flusher)
    if result then
        local figures = result.fig
        if figures then
            for f=1, #figures do
                info("flushing figure %s",f)
                local figure = figures[f]
                local objects = getobjects(result,figure,f)
                local fignum = tonumber(stringmatch(figure:filename(),"([%d]+)$") or figure:charcode() or 0)
                local miterlimit, linecap, linejoin, dashed = -1, -1, -1, false
                local bbox = figure:boundingbox()
                local llx, lly, urx, ury = bbox[1], bbox[2], bbox[3], bbox[4] -- faster than unpack
                if urx < llx then
                    -- invalid
                    pdf_startfigure(fignum,0,0,0,0)
                    pdf_stopfigure()
                else
```

Insert `verbatimtex` code before mplib box.

```
                    if TeX_code_t[f] then
                        texsprint(TeX_code_t[f])
                    end
                    pdf_startfigure(fignum,llx,lly,urx,ury)
                    pdf_literalcode(”q”)
                    if objects then
                        for o=1,#objects do
                            local object        = objects[o]
                            local objecttype    = object.type
```

Change from ConTEXt code: the following 5 lines are part of the `btex...etex` patch.
Again, colors are processed at this stage.

```
                            local prescript     = object.prescript
                            prescript = prescript and script2table(prescript) -- pre-
  script is now a table
                            local tr_opaq,shade_no = do_preobj_color(object,prescript)
                            if prescript and prescript.MPlibTEXboxID then
                                putTEXboxes(object,prescript)
                            elseif objecttype == ”start_bounds” or objecttype == ”stop_bounds” then
                                -- skip
                            elseif objecttype == ”start_clip” then
                                pdf_literalcode(”q”)
                                flushnormalpath(object.path,t,false)
                                pdf_literalcode(”W n”)
                            elseif objecttype == ”stop_clip” then
                                pdf_literalcode(”Q”)
                                miterlimit, linecap, linejoin, dashed = -1, -1, -1, false
                            elseif objecttype == ”special” then
                                -- not supported
                            elseif objecttype == ”text” then
                                local ot = object.transform -- 3,4,5,6,1,2
                                pdf_literalcode(”q %f %f %f %f %f %f cm”,ot[3],ot[4],ot[5],ot[6],ot[1],
                                pdf_textfigure(object.font,object.dsize,object.text,object.width,object
                                pdf_literalcode(”Q”)
                            else
```

Color stuffs are modified and moved to several lines above.

```
                                local ml = object.miterlimit
                                if ml and ml ~= miterlimit then
                                    miterlimit = ml
                                    pdf_literalcode(”%f M”,ml)
                                end
                                local lj = object.linejoin
                                if lj and lj ~= linejoin then
                                    linejoin = lj
                                    pdf_literalcode(”%i j”,lj)
                                end
                                local lc = object.linecap
                                if lc and lc ~= linecap then
```

```
                                    linecap = lc
                                    pdf_literalcode("%i J",lc)
                                end
                                local dl = object.dash
                                if dl then
                                    local d = format("[%s] %i d",tableconcat(dl.dashes or {}," "),dl.of
                                    if d ~= dashed then
                                        dashed = d
                                        pdf_literalcode(dashed)
                                    end
                                elseif dashed then
                                   pdf_literalcode("[] 0 d")
                                   dashed = false
                                end
                                local path = object.path
                                local transformed, penwidth = false, 1
                                local open = path and path[1].left_type and path[#path].right_type
                                local pen = object.pen
                                if pen then
                                   if pen.type == 'elliptical' then
                                        transformed, penwidth = pen_characteris-
tics(object) -- boolean, value
                                        pdf_literalcode("%f w",penwidth)
                                        if objecttype == 'fill' then
                                            objecttype = 'both'
                                        end
                                   else -- calculated by mplib itself
                                        objecttype = 'fill'
                                   end
                                end
                                if transformed then
                                    pdf_literalcode("q")
                                end
                                if path then
                                    if transformed then
                                        flushconcatpath(path,open)
                                    else
                                        flushnormalpath(path,open)
                                    end
```

Change from ConTEXt code: color stuff

```
                                    if not shade_no then ----- conflict with shad-
ing
                                        if objecttype == "fill" then
                                            pdf_literalcode("h f")
                                        elseif objecttype == "outline" then
                                            pdf_literalcode((open and "S") or "h S")
                                        elseif objecttype == "both" then
                                            pdf_literalcode("h B")
                                        end
```

```
                                    end
                                end
                                if transformed then
                                    pdf_literalcode(”Q”)
                                end
                                local path = object.htap
                                if path then
                                    if transformed then
                                        pdf_literalcode(”q”)
                                    end
                                    if transformed then
                                        flushconcatpath(path,open)
                                    else
                                        flushnormalpath(path,open)
                                    end
                                    if objecttype == ”fill” then
                                        pdf_literalcode(”h f”)
                                    elseif objecttype == ”outline” then
                                        pdf_literalcode((open and ”S”) or ”h S”)
                                    elseif objecttype == ”both” then
                                        pdf_literalcode(”h B”)
                                    end
                                    if transformed then
                                        pdf_literalcode(”Q”)
                                    end
                                end
--                              if cr then
--                                  pdf_literalcode(cr)
                                end
                            end
```

Added to ConTEXt code: color stuff

```
                                do_postobj_color(tr_opaq,shade_no)
                            end
                        end
                        pdf_literalcode(”Q”)
                        pdf_stopfigure()
                    end
                end
            end
        end
    end
end
luamplib.flush = flush

local function colorconverter(cr)
    local n = #cr
    if n == 4 then
        local c, m, y, k = cr[1], cr[2], cr[3], cr[4]
        return format(”%.3g %.3g %.3g %.3g k %.3g %.3g %.3g %.3g K”,c,m,y,k,c,m,y,k), ”0 g 0 G”
    elseif n == 3 then
```

```
        local r, g, b = cr[1], cr[2], cr[3]
        return format("%.3g %.3g %.3g rg %.3g %.3g %.3g RG",r,g,b,r,g,b), "0 g 0 G"
    else
        local s = cr[1]
        return format("%.3g g %.3g G",s,s), "0 g 0 G"
    end
end
luamplib.colorconverter = colorconverter
```

2.2 TEX package

⟨*package⟩

First we need to load some packages.

```
\bgroup\expandafter\expandafter\expandafter\egroup
\expandafter\ifx\csname ProvidesPackage\endcsname\relax
  \input luatexbase-modutils.sty
\else
  \NeedsTeXFormat{LaTeX2e}
  \ProvidesPackage{luamplib}
    [2013/12/29 v2.2 mplib package for LuaTeX]
  \RequirePackage{luatexbase-modutils}
  \RequirePackage{pdftexcmds}
\fi
```

Loading of lua code.

```
\RequireLuaModule{luamplib}
```

Set the format for metapost.

```
\def\mplibsetformat#1{%
  \directlua{luamplib.setformat("\luatexluaescapestring{#1}")}}
```

MPLib only works in PDF mode, we don't do anything if we are in DVI mode, and we output a warning.

```
\ifnum\pdfoutput>0
    \let\mplibtoPDF\pdfliteral
\else
    %\def\MPLIBtoPDF#1{\special{pdf:literal direct #1}} % not ok yet
    \def\mplibtoPDF#1{}
    \expandafter\ifx\csname PackageWarning\endcsname\relax
      \write16{}
      \write16{Warning: MPLib only works in PDF mode, no figure will be output.}
      \write16{}
    \else
      \PackageWarning{mplib}{MPLib only works in PDF mode, no figure will be out-
  put.}
    \fi
\fi
\def\mplibsetupcatcodes{%
  \catcode`\{=12 \catcode`\}=12 \catcode`\#=12
  \catcode`\^=12 \catcode`\~=12 \catcode`\_=12
```

```
  %catcode`\%=12 %% don't in Plain!
  \catcode`\&=12 \catcode`\$=12
}
```

Make `btex...etex` box zero-metric.

```
\def\mplibputtextbox#1{\vbox to 0pt{\vss\hbox to 0pt{\raise\dp#1\copy#1\hss}}}
```

The Plain-specific stuff.

```
\bgroup\expandafter\expandafter\expandafter\egroup
\expandafter\ifx\csname ProvidesPackage\endcsname\relax
\def\mplibcode{%
  \begingroup
  \bgroup
  \mplibsetupcatcodes
  \mplibdocode %
}
\long\def\mplibdocode#1\endmplibcode{%
  \egroup
  \directlua{
    luamplib.tempdata = luamplib.makeTEXboxes([===[\unexpanded{#1}]===])
  }%
  \directlua{
    luamplib.processwithTEXboxes(luamplib.tempdata)
  }%
  \endgroup
}
\else
```

The LaTeX-specific parts: a new environment.

```
\newenvironment{mplibcode}{\toks@{}\ltxdomplibcode}{}
\def\ltxdomplibcode{%
  \bgroup
  \mplibsetupcatcodes
  \ltxdomplibcodeindeed %
}
%
\long\def\ltxdomplibcodeindeed#1\end{%
  \egroup
  \toks@\expandafter{\the\toks@#1}\ltxdomplibcodefinally%
}%
%
\def\ltxdomplibcodefinally#1{%
  \ifnum\pdf@strcmp{#1}{mplibcode}=\z@
    \directlua{
      luamplib.tempdata = luamplib.makeTEXboxes([===[\the\toks@]===])
    }%
    \directlua{
      luamplib.processwithTEXboxes(luamplib.tempdata)
    }%
    \end{mplibcode}%
  \else
```

```
    \toks@\expandafter{\the\toks@\end{#1}}\expandafter\ltxdomplibcode
  \fi%
}
\fi
```

We use a dedicated scratchbox.

```
\ifx\mplibscratchbox\undefined \newbox\mplibscratchbox \fi
```

We encapsulate the litterals.

```
\def\mplibstarttoPDF#1#2#3#4{%
  \hbox\bgroup
  \xdef\MPllx{#1}\xdef\MPlly{#2}%
  \xdef\MPurx{#3}\xdef\MPury{#4}%
  \xdef\MPwidth{\the\dimexpr#3bp-#1bp\relax}%
  \xdef\MPheight{\the\dimexpr#4bp-#2bp\relax}%
  \parskip0pt%
  \leftskip0pt%
  \parindent0pt%
  \everypar{}%
  \setbox\mplibscratchbox\vbox\bgroup
  \noindent
}
\def\mplibstoptoPDF{%
  \egroup %
  \setbox\mplibscratchbox\hbox %
    {\hskip-\MPllx bp%
     \raise-\MPlly bp%
     \box\mplibscratchbox}%
  \setbox\mplibscratchbox\vbox to \MPheight
    {\vfill
     \hsize\MPwidth
     \wd\mplibscratchbox0pt%
     \ht\mplibscratchbox0pt%
     \dp\mplibscratchbox0pt%
     \box\mplibscratchbox}%
  \wd\mplibscratchbox\MPwidth
  \ht\mplibscratchbox\MPheight
  \box\mplibscratchbox
  \egroup
}
```

Text items have a special handler.

```
\def\mplibtextext#1#2#3#4#5{%
  \begingroup
  \setbox\mplibscratchbox\hbox
    {\font\temp=#1 at #2bp%
     \temp
     #3}%
  \setbox\mplibscratchbox\hbox
    {\hskip#4 bp%
     \raise#5 bp%
```

```
    \box\mplibscratchbox}%
  \wd\mplibscratchbox0pt%
  \ht\mplibscratchbox0pt%
  \dp\mplibscratchbox0pt%
  \box\mplibscratchbox
  \endgroup
}
```

That's all folks!

⟨/package⟩

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