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# Playing with Flash in ConT<sub>E</sub>Xt-mkiv

## Animace ve Flashi pomocí ConT<sub>E</sub>Xt-mkiv

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**Abstract:** Starting from release 9 AdobeReader, the reference PDF viewer from Adobe, has a Flash player embedded. The recent addition to CTAN of flashmovie package by Timo Hartmann prompted me to investigate the feasibility of an integration between ConT<sub>E</sub>Xt-mkiv and swf figures. All tests were performed under Linux Ubuntu 8.04 with AdobeReader 9.3.3 installed, but I suppose they also work under Windows or Mac operating systems.

**Keywords:** Flash, Flash animation, ConT<sub>E</sub>Xt, Mark IV, Lua

**Abstrakt:** Článek představuje jednu z možností, jak vložit animace vytvořené ve Flashi do PDF. Používá na to ConT<sub>E</sub>Xt-mkiv, který využívá programovacího jazyka Lua.

**Klíčová slova:** Flash, animace ve Flashi, ConT<sub>E</sub>Xt, Mark IV, jazyk Lua

## Introduction

In the Issue 2010, Number 1 of th PracT<sub>E</sub>X journal I have published a first tentative to support SWF files in ConT<sub>E</sub>Xt-mkiv. It was a literal translation of the `flashmovie.sty` stylesheet [2] and the result was an unusual mix of pdfL<sub>A</sub>T<sub>E</sub>X and ConT<sub>E</sub>Xt-mkiv code, but the main reason was to gain a good knowledge of the specifications and to test some applications. Just before the article was published Hans translated the stylesheet into the ConT<sub>E</sub>Xt-mkiv lingo, so ConT<sub>E</sub>Xt users can already use the swf files as figures: what I suggest here is a *all-or-nothing* way to implement the requirements of specification and also show some applications.

## Implementation

The first step to support SWF files as external figures in ConT<sub>E</sub>Xt-mkiv is to register the swf interface into the `grph-inc.mkiv` file with `\registercctxluafile:`

```
grph-inc.mkiv:
\registerctxluafile{grph-swf}{1.001} % this will change
```

Inside `grph-swf.lua` the function `figures.checkers.swf(data)` inserts the annotation object that identifies the swf figure using the good old `\pdfannotation` macro instead of a Lua function `node.write(pdfannotation(width,-height,0,annot()))` (the code is commented, as one can see), but it's one of the fews still present:

```
grph-swf.lua:
local format = string.format
local texspint = tex.sprint
local ctxcatcodes = tex.ctxcatcodes
local pdfannotation = nodes.pdfannotation
function figures.checkers.swf(data)
  local dr, du, ds = data.request, data.used, data.status
  local width = (dr.width or figures.defaultwidth):todimen()
  local height = (dr.height or figures.defaultheight):todimen()
  local foundname = du.fullname
  local controls = dr.controls or nil
  local display = dr.display or nil
  dr.width, dr.height = width, height
  du.width, du.height, du.foundname = width, height, foundname
  texspint(ctxcatcodes,format(
    "\\ startfoundexternalfigure{%ssp}{%ssp}",width,height))
  local annot, preview, ref = backends.pdf.helpers.insertswf {
    foundname = foundname,
    width      = width,
    height     = height,
    -- factor   = number.dimenfactors.bp,
    display    = display,
    controls   = controls,
    -- label    = dr.label,
  }
  -- node.write(pdfannotation(width,-height,0,annot()))
  texspint(ctxcatcodes,format("\\ pdfannot width %ssp height %ssp {%s}",
    width,height,annot()))
-- brrrrr
  texspint(ctxcatcodes,"\\ stopfoundexternalfigure")
  return data
end
figures.includers.swf = figures.includers.nongeneric
figures.registersuffix("swf","swf")
```

Actually the code before is modification of mine, where I've simply un-commented the `display` and `controls` variables because I need them later. The complete specifications consist of the PDF Reference sixth edition book and Adobe® Supplement to the ISO 32000 BaseVersion: 1.7 ExtensionLevel: 3 both available

from [1]. The chapter 9.6 Rich Media of the Supplement describes the additional entries of the RichMedia annotation dictionary, and it's the guide to what follow; carefully reading of the RichMedia chapter and the code below reveals that there is almost an one-to-one map between the specifications and the implementation that is done by the Lua tables:

```

local format = string.format
local pdfconstant = lpdf.constant
local pdfboolean = lpdf.boolean
local pdfstring = lpdf.string
local pdfunicode = lpdf.unicode
local pdfdictionary = lpdf.dictionary
local pdfarray = lpdf.array
local pdfnull = lpdf.null
local pdfreference = lpdf.reference
function backends.pdf.helpers.insertswf(spec)
    local width, height, filename = spec.width, spec.height, spec.foundname
    local controls = spec.controls or nil
    local display = spec.display or nil
    if controls = 'no' then
        if (parametersets[controls].replace_helper == true) and
            (type(parametersets[controls].private_helper) == "function") then
            local annotation
            annotation = parametersets[controls].private_helper(spec)
            return annotation,nil,nil
        end
    end
end
local eref = backends.codeinjections.embedfile(filename)
local configuration = pdfdictionary {
    Type = pdfconstant("RichMediaConfiguration"),
    Subtype = pdfconstant("Flash"),
    Instances = pdfarray {
        pdfdictionary {
            Type = pdfconstant("RichMediaInstance"),
            Subtype = pdfconstant("Flash"),
            Params = pdfdictionary {
                Type = pdfconstant("RichMediaParams"),
                -- FlashVars =
                Binding = pdfconstant("Foreground")
            },
            Asset = eref
        },
    },
}
local configuration_ref = pdfreference(pdf.immediateobj(tostring(configuration)))
local content = pdfdictionary {
    Type = pdfconstant("RichMediaContent"),
    Assets = pdfdictionary {
        Names = pdfarray {
            pdfstring(filename),

```

```

        eref,
    }
},
Contents = pdfarray { configuration_ref },
}
local content_ref = pdfreference(pdf.immediateobj(tostring(content)))
local settings = pdfdictionary {
    Type = pdfconstant("RichMediaSettings") ,
    Activation = pdfdictionary {
        Type = pdfconstant("RichMediaActivation"),
        Condition = pdfconstant("PO"),
        Animation = pdfdictionary {
            Subtype = pdfconstant("Linear"),
            Playcount = 1,
            Speed = 1,
        },
    },
    Configuration = configuration_ref,
    Presentation = pdfdictionary {
        PassContextClick = true,
        Style = pdfconstant("Embedded"),
        Toolbar = false,
        NavigationPane = false,
        Transparent = true,
        Window = pdfdictionary {
            Type = pdfconstant("RichMediaWindow"),
            Width = pdfdictionary {
                Default = 100,
                Min = 100,
                Max = 100,
            },
            Height = pdfdictionary {
                Default = 100,
                Min = 100,
                Max = 100,
            },
            Position = pdfdictionary {
                Type = pdfconstant("RichMediaPosition"),
                HAlign = pdfconstant("Near"),
                VAlign = pdfconstant("Near"),
                HOffset = 0,
                VOffset = 0,
            }
        }
    },
},
Deactivation = pdfdictionary {
    Type = pdfconstant("RichMediaDeactivation"),
    Condition = pdfconstant("XD"),
},
}

```

```

local settings_ref = pdfreference(pdf.immediateobj(tostring(settings)))
local annotation = pdfdictionary {
  Subtype          = pdfconstant("RichMedia"),
  RichMediaSettings = settings_ref,
  RichMediaContent = content_ref,
}
return annotation, nil, nil
end

```

RichMedia annotations have a huge set of options and the more convenient way to manage them is by a Lua table: ConTeXt-mkiv has an experimental mechanism that uses the global table `parametersets` to store and retrieve the values. What follow is not the canonical syntax `\startluaparameterset [<namespace>] ..\stopluaparameterset` but a Lua version that is essentially the same:

```

\startluacode parametersets["swf:Main:controls:1"] = {
  replace_helper = true,
  private_helper = document.lscarlo.insertswf
\stopluacode
\externalfigure[Main.swf][width=320px,height=180px,controls=swf:Main:controls:1]

```

The idea is clear: there is only one option `controls` instead of many keys/values and this option “points” to a dictionary of keys/values. ConTeXt-mkiv has also another option `display`, because the idea is a clear separation between presentation and control, but I’ve not used it in my implementation. The standard support for `swf` figures doesn’t manage the option `controls`, so I have added my own code:

```

local controls = spec.controls or nil
local display = spec.display or nil
if controls = 'no' then
  if (parametersets[controls].replace_helper == true) and
    (type(parametersets[controls].private_helper) == "function") then
    local annotation
    annotation = parametersets[controls].private_helper(spec)
    return annotation,nil,nil
  end
end
end

```

Now it’s time to explain what I mean with “all-or-nothing”. If you want just use a `swf` figure just do *nothing*, i.e. `\externalfigure[Main.swf]` is suffice. But if you need to specify some options then you must pass them to `externalfigure` together with *all* the defaults ones, and a way to pass different options is just replace the Lua function `backends.pdf.helpers.insertswf(spec)` with a private implementation `document.lscarlo.insertswf` by storing its reference into the `swf:Main:controls:1` table. This is the meaning of

```

\startluacode
parametersets["swf:Main:controls:1"] = {
  replace_helper = true,
  private_helper = document.lscarlo.insertswf
}
\stopluacode

```

replace\_helper = true is hence a signal to backends.pdf.helpers.insertswf (spec) to replace itself with the private implementation document.lscarlo.insertswf (spec). A trivial implementation of document.lscarlo.insertswf (spec) is almost a copy of the standard backends.pdf.helpers.insertswf (spec):

```

\startluacode
document.lscarlo = document.lscarlo or {}
function document.lscarlo.insertswf(spec)
  local format = string.format
  local pdfconstant = lpdf.constant
  local pdfboolean = lpdf.boolean
  local pdfstring = lpdf.string
  local pdfunicode = lpdf.unicode
  local pdfdictionary = lpdf.dictionary
  local pdfarray = lpdf.array
  local pdfnull = lpdf.null
  local pdfreference = lpdf.reference
  local width, height, filename = spec.width, spec.height, spec.foundname
  local controls = spec.controls or nil
  local display = spec.display or nil
  local eref = backends.codeinjections.embedfile(filename)
  local configuration = pdfdictionary {
    Type = pdfconstant("RichMediaConfiguration"),
    Subtype = pdfconstant("Flash"),
    Instances = pdfarray {
      pdfdictionary {
        Type = pdfconstant("RichMediaInstance"),
        Subtype = pdfconstant("Flash"),
        Params = pdfdictionary {
          Type = pdfconstant("RichMediaParams"),
          Binding = pdfconstant("Foreground")
        },
        Asset = eref
      },
    },
  },
}
local configuration_ref = pdfreference(pdf.immediateobj(tostring(configuration)))
local content = pdfdictionary {
  Type = pdfconstant("RichMediaContent"),
  Assets = pdfdictionary {
    Names = pdfarray {
      pdfstring(filename),

```

```

        eref,
    }
},
Contents = pdfarray { configuration_ref },
}
local content_ref = pdfreference(pdf.immediateobj(tostring(content)))
local settings = pdfdictionary {
    Type = pdfconstant("RichMediaSettings"),
    Activation = pdfdictionary {
        Type = pdfconstant("RichMediaActivation"),
        Condition = pdfconstant("PO"),
        Animation = pdfdictionary {
            Subtype = pdfconstant("Linear"),
            Playcount = 1,
            Speed = 1,
        },
    Configuration = configuration_ref,
    Presentation = pdfdictionary {
        PassContextClick = true,
        Style = pdfconstant("Embedded"),
        Toolbar = false,
        NavigationPane = false,
        Transparent = true,
        Window = pdfdictionary {
            Type = pdfconstant("RichMediaWindow"),
            Width = pdfdictionary {
                Default = 100,
                Min = 100,
                Max = 100,
            },
            Height = pdfdictionary {
                Default = 100,
                Min = 100,
                Max = 100,
            },
            Position = pdfdictionary {
                Type = pdfconstant("RichMediaPosition"),
                HAlign = pdfconstant("Near"),
                VAlign = pdfconstant("Near"),
                HOffset = 0,
                VOffset = 0,
            }
        }
    },
},
Deactivation = pdfdictionary {
    Type = pdfconstant("RichMediaDeactivation"),
    Condition = pdfconstant("XD"),
},
}
local settings_ref = pdfreference(pdf.immediateobj(tostring(settings)))

```



```

local annotation = pdfdictionary {
  Subtype          = pdfconstant("RichMedia"),
  RichMediaSettings = settings_ref,
  RichMediaContent = content_ref,
}
return annotation, nil, nil
end
\stopluacode

```

The rationale behind this implementation is that most of the time the user wants to specify only some keys/values, but sometimes a bit of programming is required, as for example to calculate the indirect reference of an object. Needless to say that Lua is almost perfect for this, so it seemed to me a natural solution to delegate the user to write the appropriate function (in this way he *must know* the options and their meaning) and let ConT<sub>E</sub>Xt-mkiv replace the standard implementation with the user's one.

## Application

As simple application, I've considered the programs `as3compile` and `swfc` from the `swftools` suite [4]. The goal is to achieve something similar to `METAPOST`: typeset the code and straight insert the result into the pdf, where in this case the code is `ActionScript3` code that is compiled into a `swf` figure with the `as3compile` compiler, an external program. The implementation is also simple: the `ActionScript` code is enclosed between a couple of `start/stopSWFtoolsASCode` macros (with some options as the name of the script and the path of the compiler) that are in turn almost a verbatim copies of `start/stopluacode` macros:

```

\long\def\dostartSWFtoolsASCode[#1]
  {\getparameters[as.][ name={out-as},preamble=preamble,compiler=as3compile,#1]%
  \begingroup
  \obeylualines %% yes, lua
  \obeyluatokens %% yes, lua
  \dodostartSWFtoolsASCode}
\long\def\dodostartSWFtoolsASCode#1\stopSWFtoolsASCode
  {\normalexpanded{\endgroup\noexpand\dododostartSWFtoolsASCode[#1]}}%
\long\def\dododostartSWFtoolsASCode[#1]{
\startluacode
  local preamble = ''
  local outfile = tostring("\csname as.name\endcsname") .. ".as"
  local swffile = tostring("\csname as.name\endcsname") .. ".swf"
  local ascompiler = tostring("\csname as.compiler\endcsname")
  local asscript_body = [= #1 =]
  print('')
  local asscript = preamble .. asscript_body
  io.savedata(outfile,asscript)

```

```

as_execute = string.format("\%s \%s -o \%s ",ascompiler,outfile,swffile)
os.execute(as_execute)
\stopluacode%
}
\unexpanded\ef\startSWFtoolsAScode{\ostartSWFtoolsAScode} % lua catcodes
\startSWFtoolsAScode[name=smile,
compiler={/opt/luatex/minimals-2010-brejlov/tex/texmf-project/bin/as3compile}]
package
{
import flash.display.MovieClip
public class Main extends MovieClip
{
function Main()
{
this.graphics.beginFill(0xcccc00)
this.graphics.drawCircle(200,200,200)
this.graphics.endFill()
this.graphics.beginFill(0x000000)
this.graphics.drawCircle(140,150,50)
this.graphics.drawCircle(260,150,50)
this.graphics.drawRoundRect(140,270,120,10,20);
this.graphics.endFill()
}
}
}
\stopSWFtoolsAScode
\externalfigure[smile.swf] [width=100px,height=100px]

```



We should also supply a default representation for the viewers that are unable to display swf figures, but this time it's not necessary to specify complicated options: just use the mode feature of ConT<sub>E</sub>Xt as in the following example

```

\startmode[Flash]
\externalfigure[smile.swf] [width=100px,height=100px]
\stopmode
\startnotmode[Flash]
\externalfigure[smile.png]
\stopnotmode

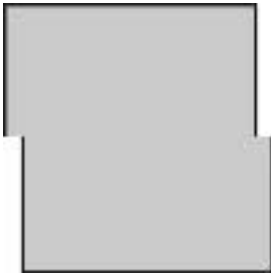
```

The same approach can be used to implement the start/stopSWFtoolsSCcode macros where the code is a swf script and the compiler is swfc (both are proprietary of swftools, see [5]):

```

\startSWFtoolsSCcode[name=action,
  compiler={/opt/luatex/minimals-2010-brejlov/tex/texmf-project/bin/swfc}]
.flash filename="action.swf" bbox=300x300 fps=50
.box mybox color=blue fill=green width=100 height=100
.put mybox
.frame 1
  .action:
    _root.angle += 0.05;
    mybox._x = 100*Math.cos(_root.angle)+100;
    mybox._y = 100*Math.sin(_root.angle)+100;
  .end
.frame 2
  .action:
    gotoFrame(0);
    Play();
  .end
.frame 3
.end
\stopSWFtoolsSCcode
\externalfigure[action.swf] [width=150px,height=150px]

```



## Conclusion

From the point of view of a *traditional* (i.e. not  $\text{\TeX}$ ) programmer  $\text{\ConTeXt-mkiv}$  has a neat approach for implementing the PDF specifications. The Lua language is small and complete, and the PDF specifications itself are clear enough: the problem arises with the rendering of the document. On average, a free PDF viewer other than AdobeReader has not the capability to show a RichMedia content and the printing of the pdf can be also problematic, so we **must** supply the correct alternative content at least with the `modes` mechanism. Following the same way of `start/stopSWFtoolsAScode` it is possible to implement a `start/stopFlexAScode` (see [6]) which is the preferable to the `swftools` compiler due some incompatibilities in the implementation of the ActionScript3 language.

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