Common Lisp in 3D CAD: CoCreate Modeling
European Lisp Symposium 2009
Who's this guy?

Software architect at Parametric Technology

Working in the CoCreate Modeling team since 1991

Belated Lisp convert (it (took (me (ten years!))))

http://www.clausbrod.de/Blog
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CoCreate Modeling

One of the leading 3D CAD modelers in the mechanical engineering and electronics markets

*The leader in „explicit modeling“*

Initial prototyping started 1989, first release in 1992

Main implementation languages: C++, Common Lisp
Common Lisp in CoCreate Modeling

Lisp implementation („HCL“) derived from KCL and AKCL

Lisp compiler generates C/C++ code

Close to CLtL1 (pre-standard):

• No conditions
• CLOS in embryonic state
• Parts of CL „library“ missing (example: logical pathnames)
How we use Lisp in CoCreate Modeling

Embedded *configuration language* for CAD admins and end users

*Scripting language* for automation and writing tests

Foundation of action routine and dialog *DSLs*

*Implementation language* for internal and external developers

Our main external API („Integration Kit“) is a Lisp library

Bridge to COM/ActiveX/.NET
So does Lisp scale? (1)

This is a massive project

Several million lines of code in Lisp or Lisp-based DSLs (2/3 of our code overall)

Full Lisp compilation can take a day

Homegrown tools to detect dependencies

Significant distributed development team

~30 customer releases (plus patch releases)

60000 active 2D+3D users, plus 140000 registered users of free version (CoCreate Modeling PE)
So does Lisp scale? (2)

Lisp performance and memory consumption usually a minor issue

Lisp mostly used in front-end, i.e. UI and application logic

Performance-critical code (modeling kernel!) lives in C++

GBC:

• Can be a problem when loading large uncompiled multilevel macros (DSL code)

• Ameliorated by idle-time GBC
Lisp-based DSL: Action routines

Customers loved extension language in precursor product ME10 (2D CAD)

Each command is basically a mini-language, implementable as a state machine

Action routines in CoCreate Modeling:

- Define commands which accept ME10-like syntax
- Basically a state machine DSL
Action routines: simple_exit command

(defun simple_exit)
  (flag) ; local variable

  (state descriptions
    (start nil "Terminate CoCreate Modeling?" nil
      (:yes (setq flag t) answer-yes end)
      (:no (setq flag nil) answer-no end)
      (otherwise (display_error "Enter either :YES or :NO.") nil start))
    (end (do-it) nil nil))

  (local functions
    (do-it () (when flag (quit))))
Lisp-based DSL: Dialog generator

Dialog generator:
• Automatic command generation
• *Plus* automatic UI
• Specification of input variables and workflow without state machines

```
(sd-defdialog 'my_extrude
 :dialog-title "Extrude"

:variables
  '((A_PART :value-type :part-incl-new
    :modifies :contents
    :title "Part"
    :prompt-text "Identify part to extrude.
  )
  (A_WP :value-type :wp-with-profile
    :title "Workplane"
    :prompt-text "Identify workplane to extrude.
  )
  (DISTANCE :value-type :distance
    :prompt-text "Specify distance to extrude.
    :initial-value 42)

:ok-action
  '(sd-call-cmds (extrude :part a_part
    :wp a_wp
    :distance distance)))
```
Services provided for free by the dialog generator (sd-defdialog)

• Workflow
• Automatic UI generation
• Consistent look and feel
• Online help
• UNDO support
• Unit conversion
• User prompting
• Feedback (highlighting, 3D helper objects...)
• Input validation
• Command recording
• ...

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Interesting Lisp tidbits in CoCreate Modeling

Unicode support

Lisp/COM interoperability

Integration with IE - Lisp calls
JavaScript/IE, IE/JS calls Lisp

Infix input for arithmetic expressions

Vector notation:
• 0,0 is read as a 2D vector
• 42,42,42 is read as a 3D vector

Socket support

...
Links and references

Article in „HP Journal“ on action routines:

http://www.hpl.hp.com/hpjournal/95oct/oct95a7.htm

Free download (CoCreate Modeling PE):

http://www.cocreate.com/free

My ramblings:

http://www.clausbrod.de/Blog

Official company propaganda:

http://www.ptc.com/products/cocreate/modeling