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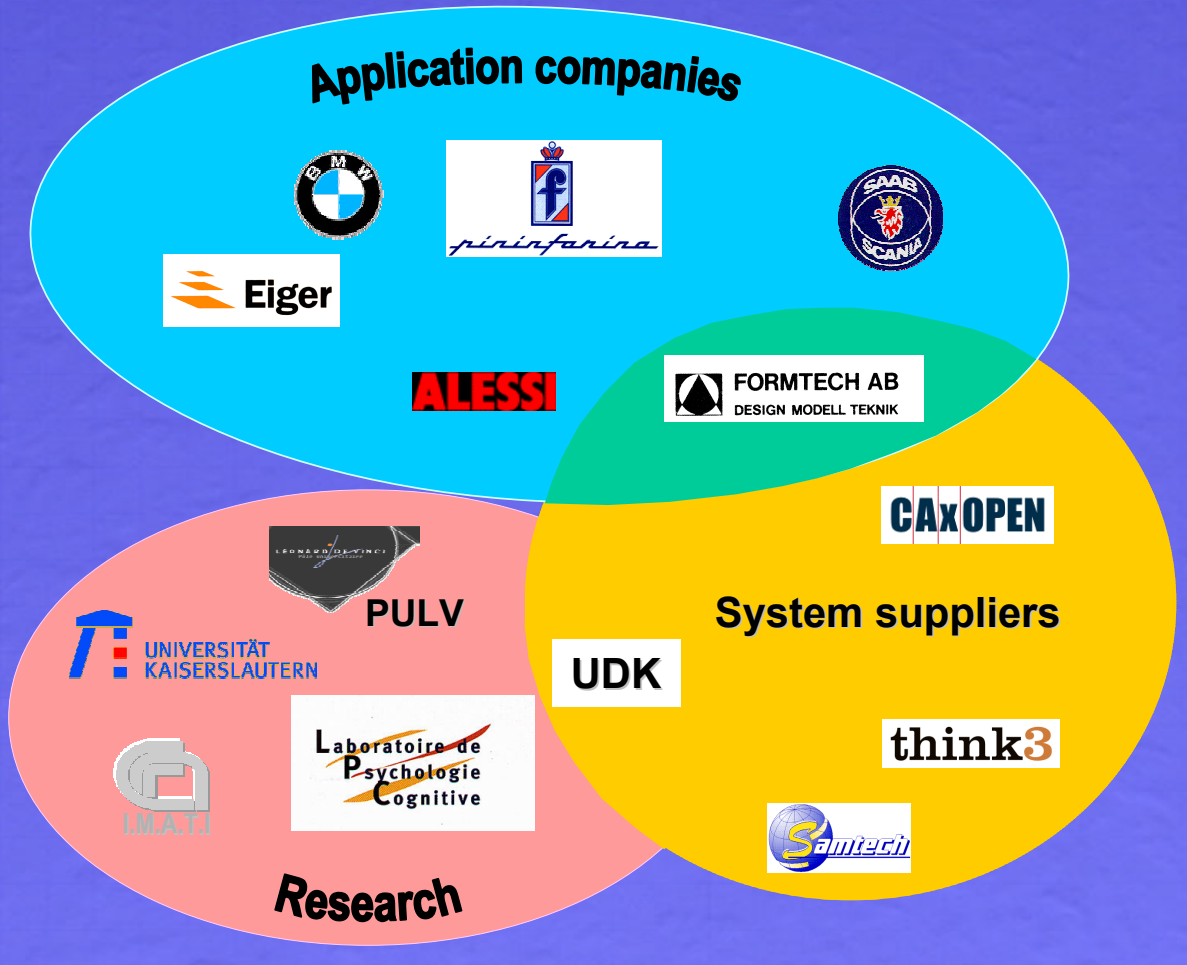
Presentation Overview

- Introduction
- The application context
- The objectives
- The adopted approach
- The Software prototype
- Current results
- Further activities & outlook

- *5th European Framework Programme*
  "Competitive And Sustainable Growth"
  Key action: "Innovative Products, Processes, Organization"
- *Predecessor:* **FIORES**
  "Formalization and Integration of
  an Optimised Reverse Engineering Styling workflow"
  ⇒
  CA tools for optimisation methods and processes in "Aesthetic Design"
- *Project duration*: **3** years (started April 1st, 2000)
- *Effort*: **44** man⊗years
- *Consortium*: **14** partners from **6** European countries (**www.fiores.com**)


Application companies
Eiger
ALESSI
FORMTECH AB
DESIGN MODELL TEKNIK
CAxOPEN
System suppliers
UDK
think3
Samtech
PULV
UNIVERSITÄT KAISERSLAUTERN
I.M.A.T.I
Laboratoire de Psychologie Cognitive
Research

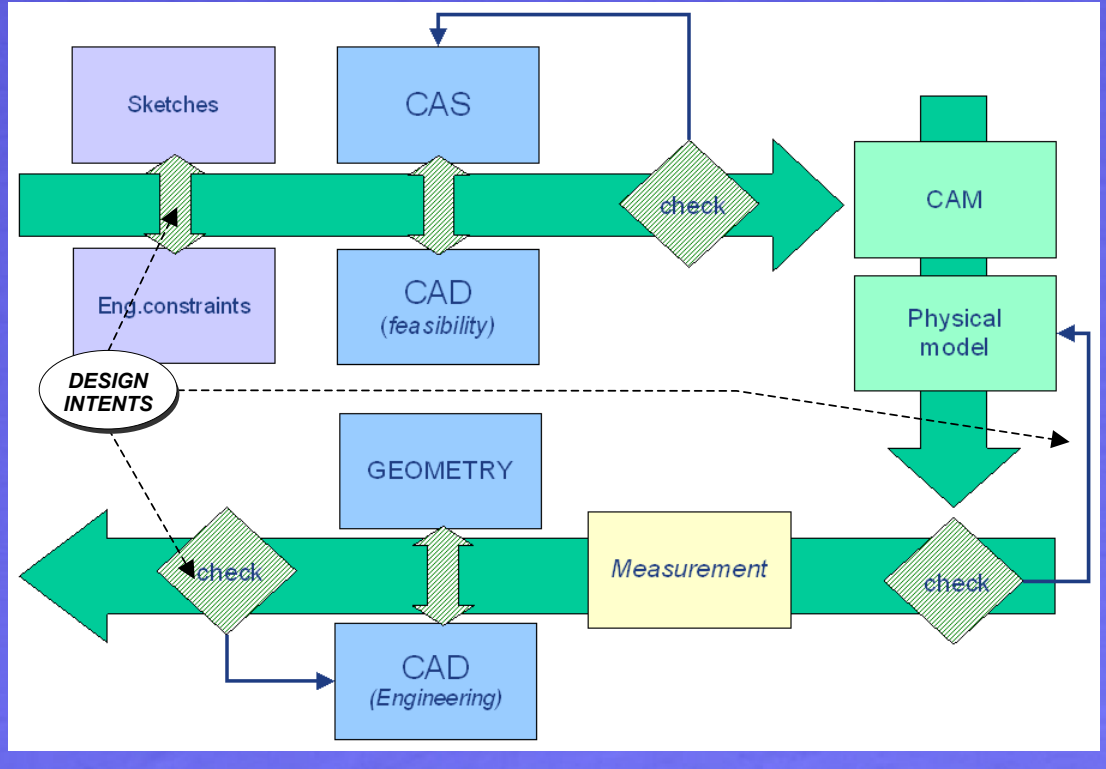
Industrial design includes the specification of all products subject to visual judgement and appreciation

- *transport vehicles*
- *home appliances*
- *furniture*
- *cosmetic containers*
- *…….*

- **Aesthetic impact** is increasingly important for the **success** of products
- **Product development** characterized by **complex work flows**
- **Digital tools** *CA Styling (CAS)* and *CA Aesthetic Design (CAAD)* are often **not adequate to styling activity**: **only geometry is handled**

  ⇒ Various refinements / optimization loops are necessary

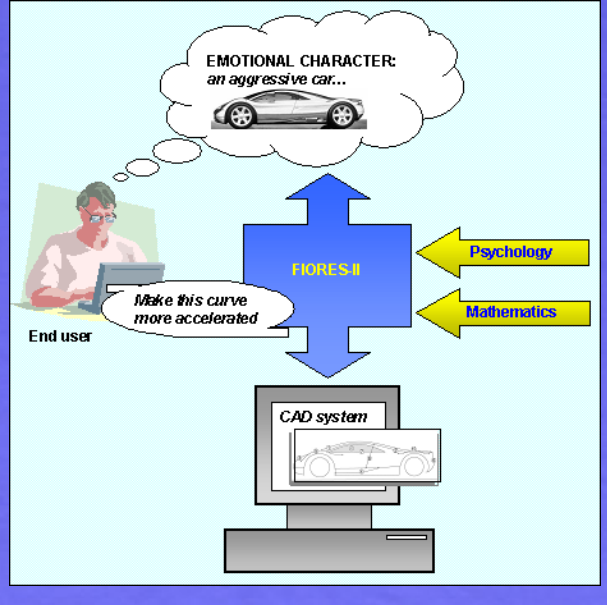
  ⇒ High time cost



The more technologically complex a product is, the more problems arise in ***preserving the aesthetic design intent*** *while respecting the engineering constraints*

- **Developing CA-tools able to:**
  - **ease designers to attain the *aesthetic character* of a product**
  - **actively preserving the *aesthetic character* of a product in the design process while satisfying *engineering constraints***

- **In our context, the Product Aesthetic Character corresponds to the designer's idea and goal (design intent), i.e.:**
  - **Corporate Identity**
  - **Emotions of consumers**



- To implement a software prototype providing the following features:
  - direct action on relevant aesthetic-wise geometrical properties
  - automatic verification of aesthetic character alteration during model modifications
  - preserving of aesthetic character during optimisations of engineering constraints
  - product classification versus given categories of aesthetic character

Text analysis , Web questionnaires and In-depth interviews
with designers and stylists

- Capturing terms used in design / styling and emotional terms used in marketing
- Identifying elements which characterize a product
- Identifying the relations between the product shape and the emotional terms

Identification of two different languages:

- **Marketing Language**
  Terms to describe the *emotional character* of a product (e.g. aggressive, sporty…)
- **Designer Language**
  Terms to communicate the design intent in a "physical" way (e.g. tension, crown…)

Marketing Language ⟷ **MAPPING** ⟷ **Designer Language**

Character specification: example of product's Aesthetic Character

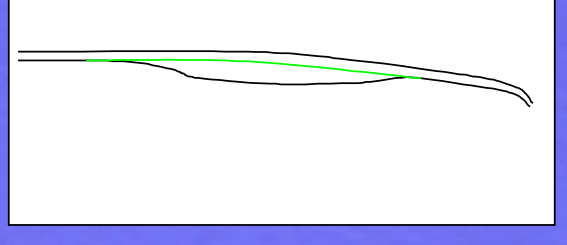
Aesthetic Character ("*sporty*", "*aggressive*", "*dynamic*"...)

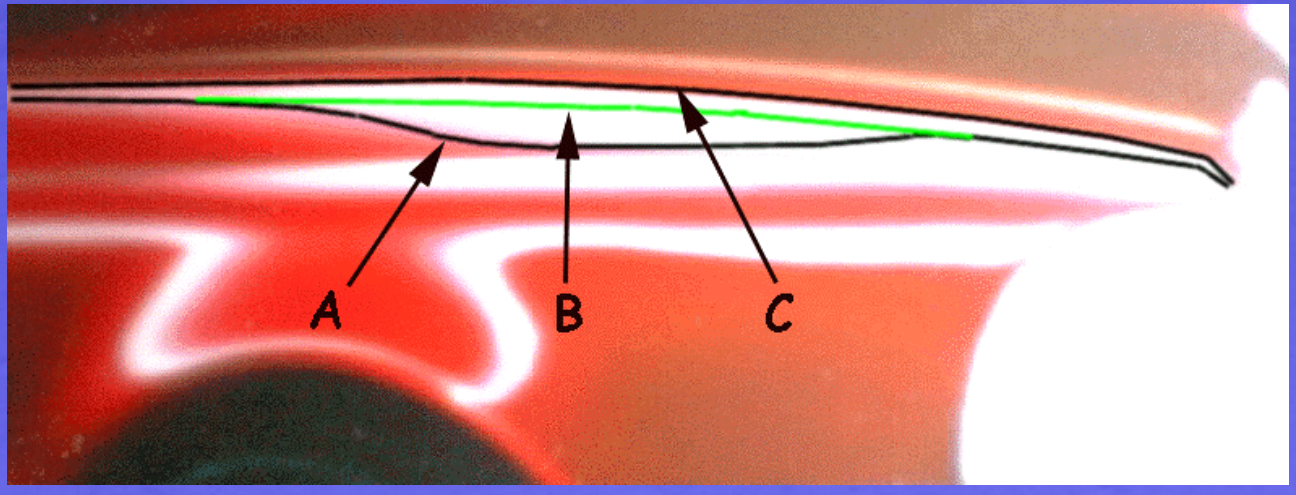
mapping on

Aesthetic properties as carrier of aesthetic character (reflection lines, shadow lines, …)

extract

Geometric properties
(reflection lines as geometric curves with length, curvature,...)



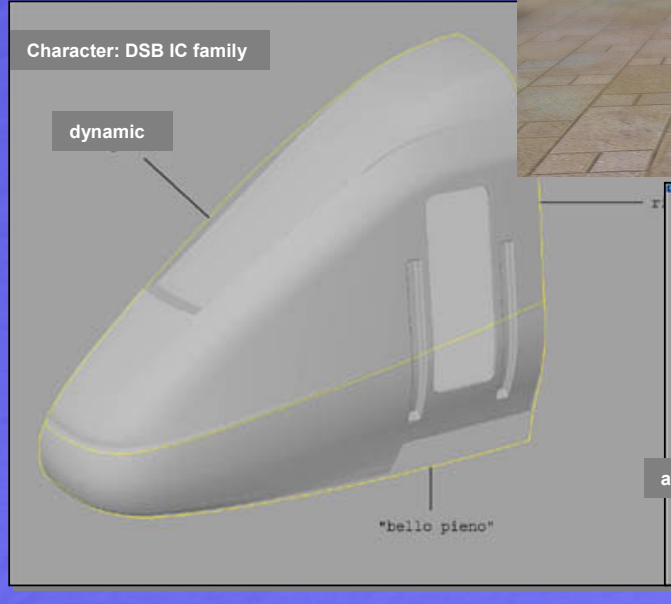


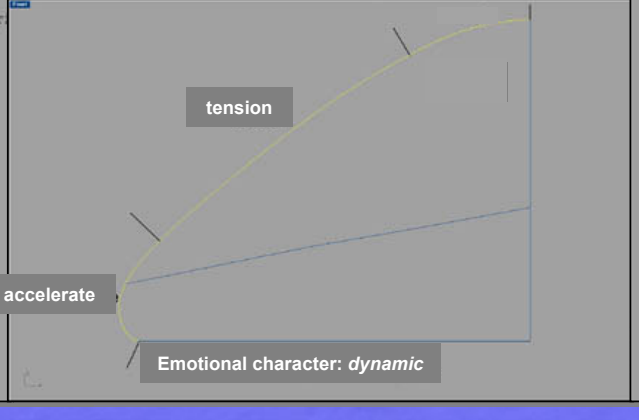
Starting point

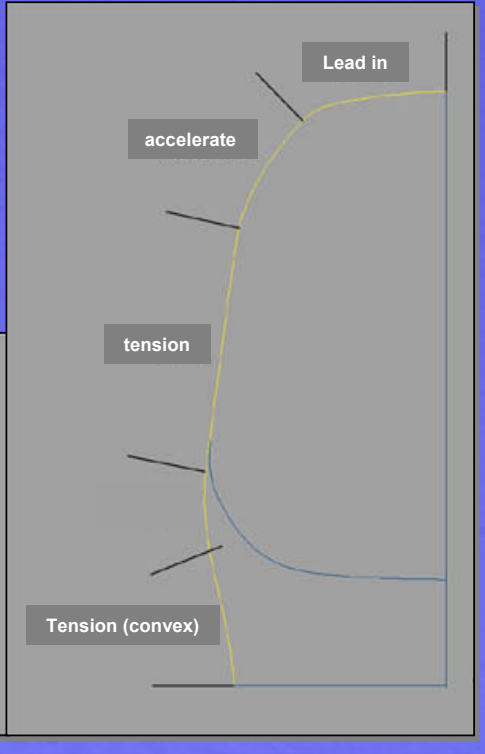
- CAD model with visualised surface properties, e.g. highlights

Working procedure

- Chose unsatisfying curve A
- Define new target curve B (now being parallel to C)
- CAx system computes corresponding surface

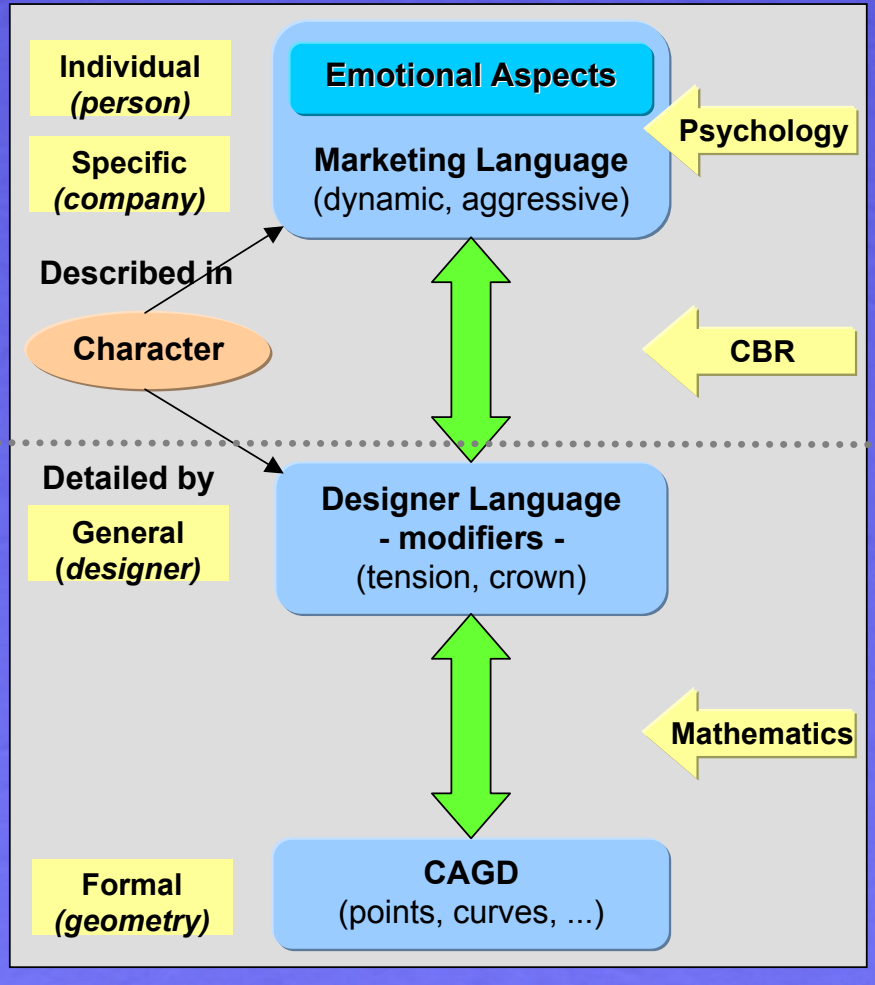

Character: DSB IC family
dynamic
"bello pieno"

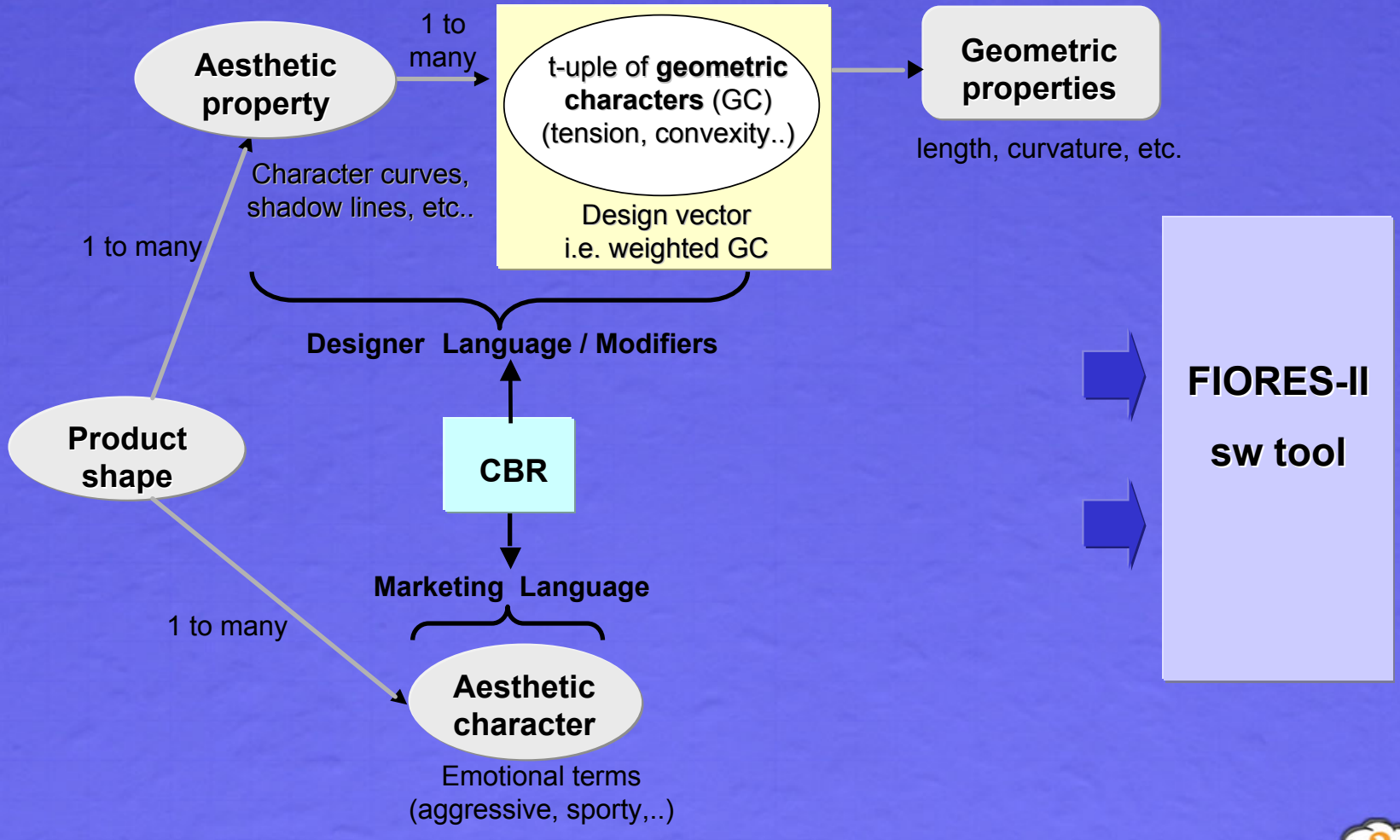

tension
accelerate
Emotional character: *dynamic*


Lead in
accelerate
tension
Tension (convex)

Emotional characterization is culture dependent

linking of the two languages with methods of *Artificial Intelligence*
⇒ Case Based Reasoning (CBR)




Aesthetic property
1 to many
t-uple of geometric characters (GC) (tension, convexity..)
Geometric properties
length, curvature, etc.
Character curves, shadow lines, etc..
Design vector i.e. weighted GC
1 to many
Designer Language / Modifiers
FIORES-II sw tool
Product shape
CBR
Marketing Language
1 to many
Aesthetic character
Emotional terms (aggressive, sporty,..)

- Special form of ***knowledge database***
- Use in FIORES-II: ***storing and controlling*** the character of products
- A ***case describes*** the aesthetic character of a given product
- Cases are being stored separately in product families
- For each product part, its aesthetic characters and the set of character relevant information are stored
- Gain of information from CBR database (***statistical methods***)
- ***Similarity measures*** by ***mapping*** *the* ***aesthetic character*** *of a product on* ***design vectors***
- ***Comparing*** the character of different products

Modifier

CAS

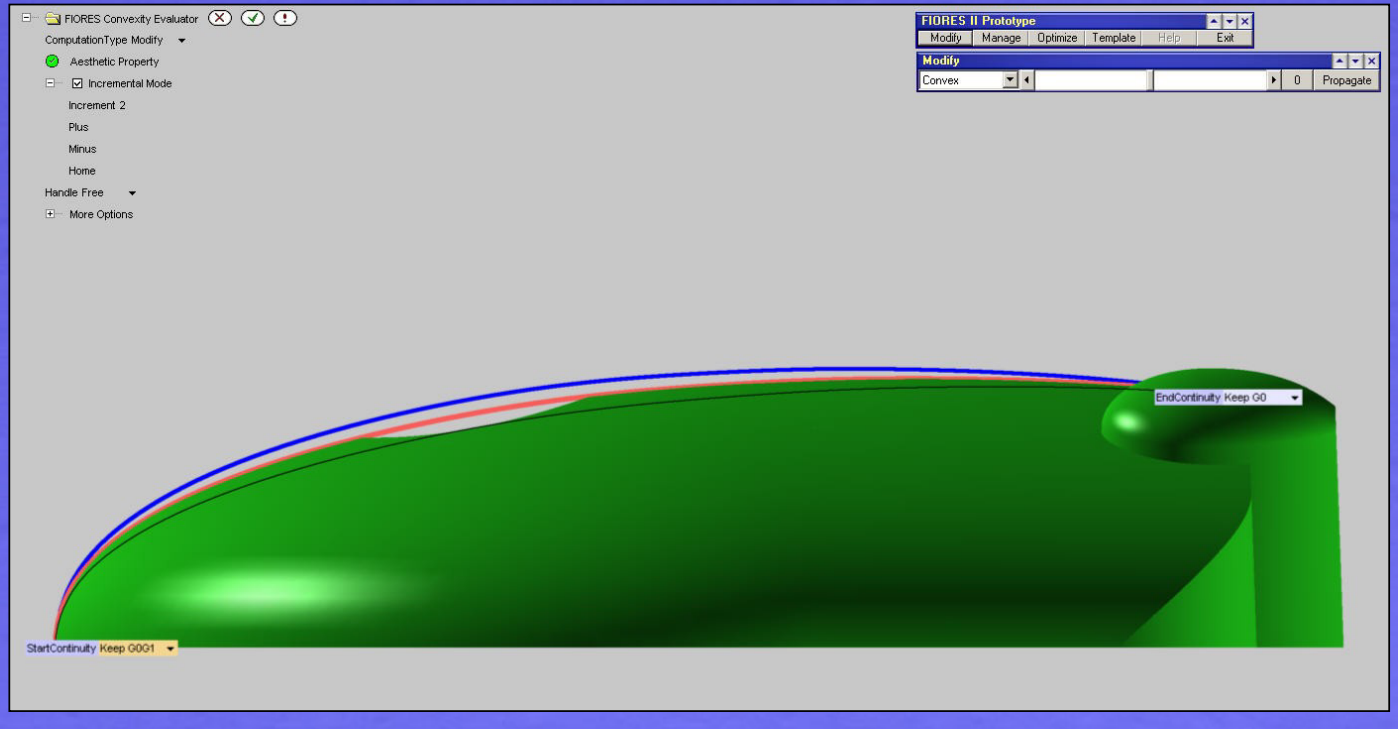
Modelling tool **for curves corresponding to some selected designer terms**

STYLE

Aesthetic feature **characterising shape from a stylist's point of view**

- Definition of the *meaning* from the designer point of view
- Identification of the *affected geometric properties*
- Specification of the:
  - mathematical function producing the expected shape modification
  - related domain of application
- Identification of the required *parameters*
- Evaluation of a *measure* of the modifier

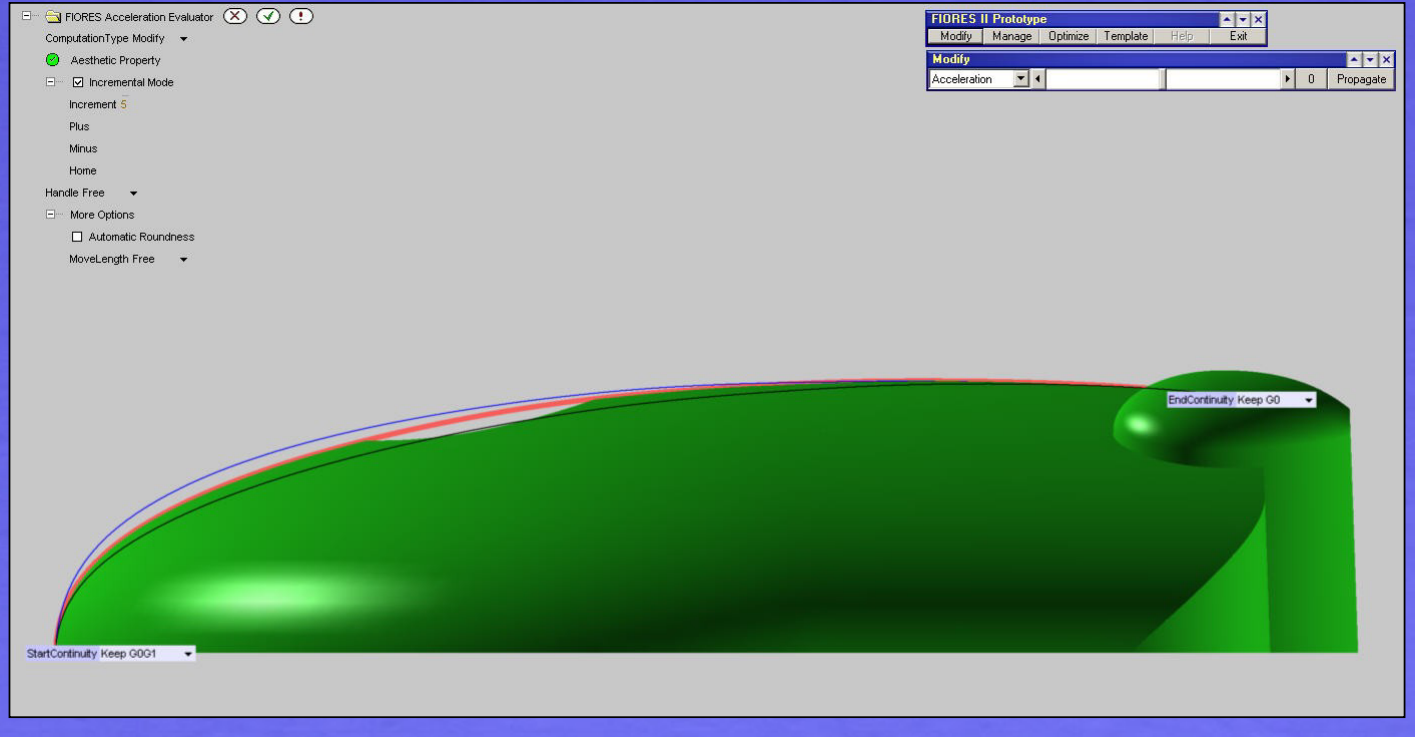
Convexity & Concavity



The curvature along planar curve has the same sign

Making a curve more *convex* leads to make it more symmetric and to reduce its curvature variation

Acceleration



Curves with "rising" curvature

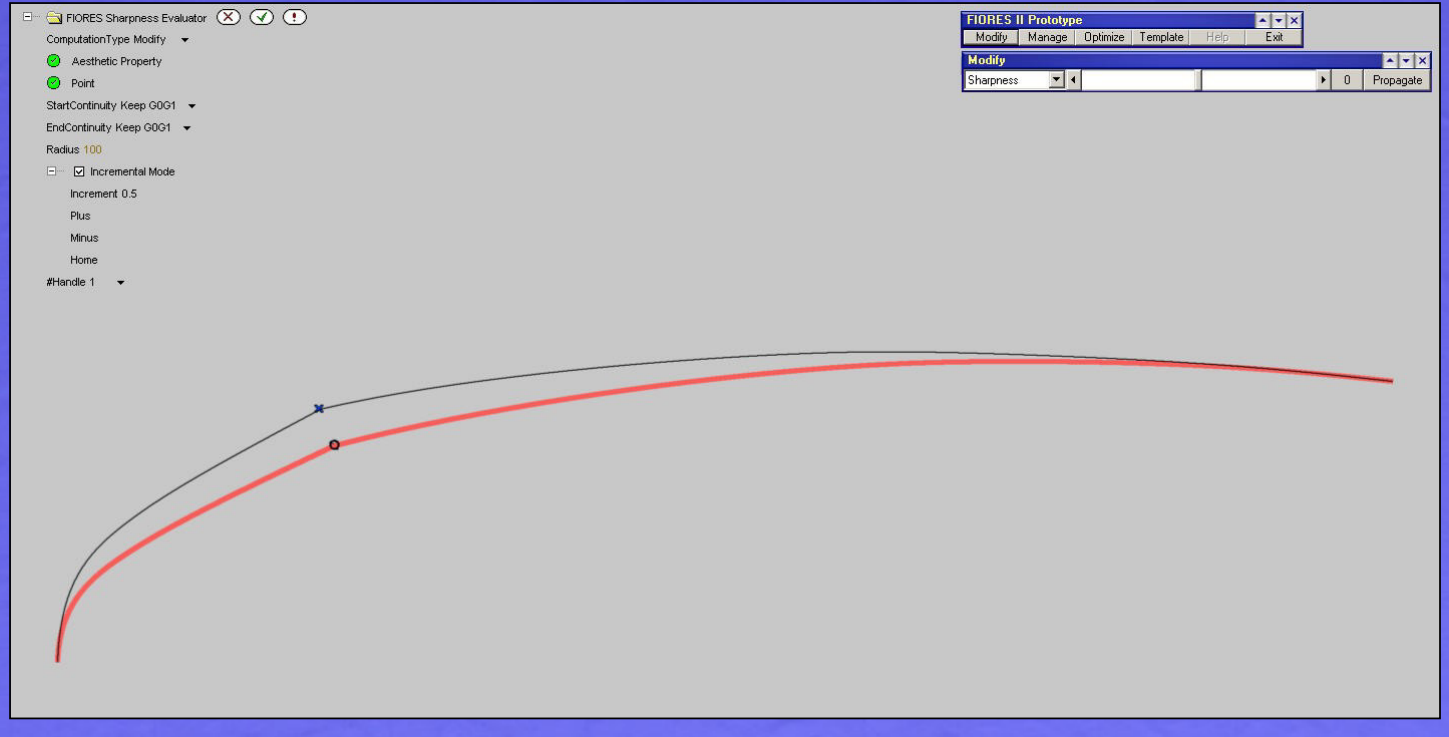
Acceleration always starts in a rather *flat* area and leads into a high curvature region (a *radius*)

A slow curvature change may show **no** acceleration at all.

Crown

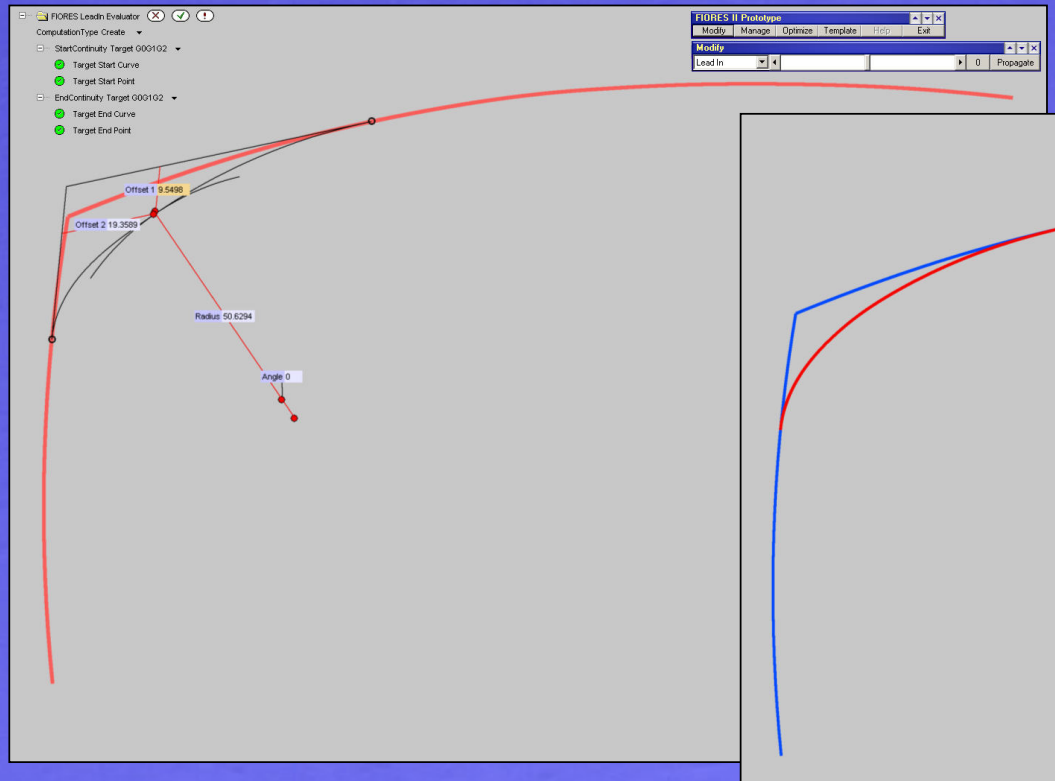
To *crown* a curve means to lift or raise a (part of) curve while keeping boundary continuity

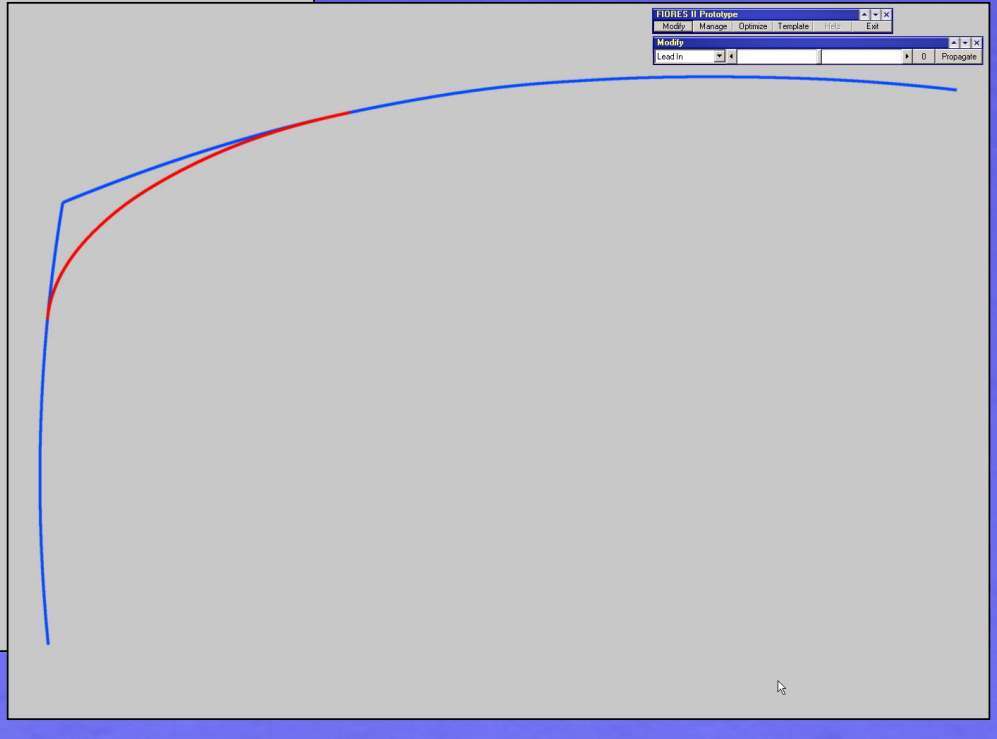
Soft / Sharp & Crisp



An edge/vertex is perceived *soft* or *sharp* depending on angles between the normal vectors to the surfaces/curves around it. *Crisp* is a qualitative characterisation for *sharp* edges and vertices.

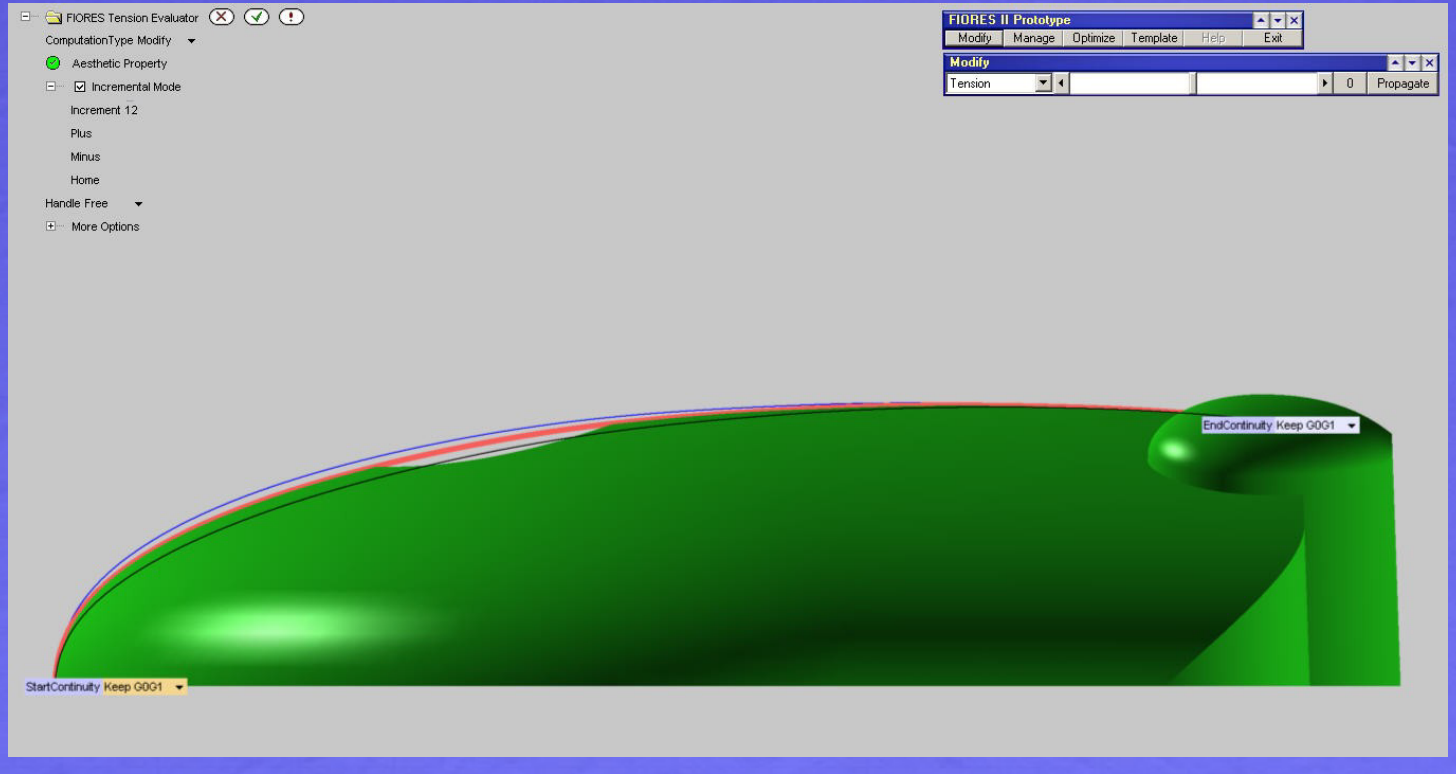
Lead-in



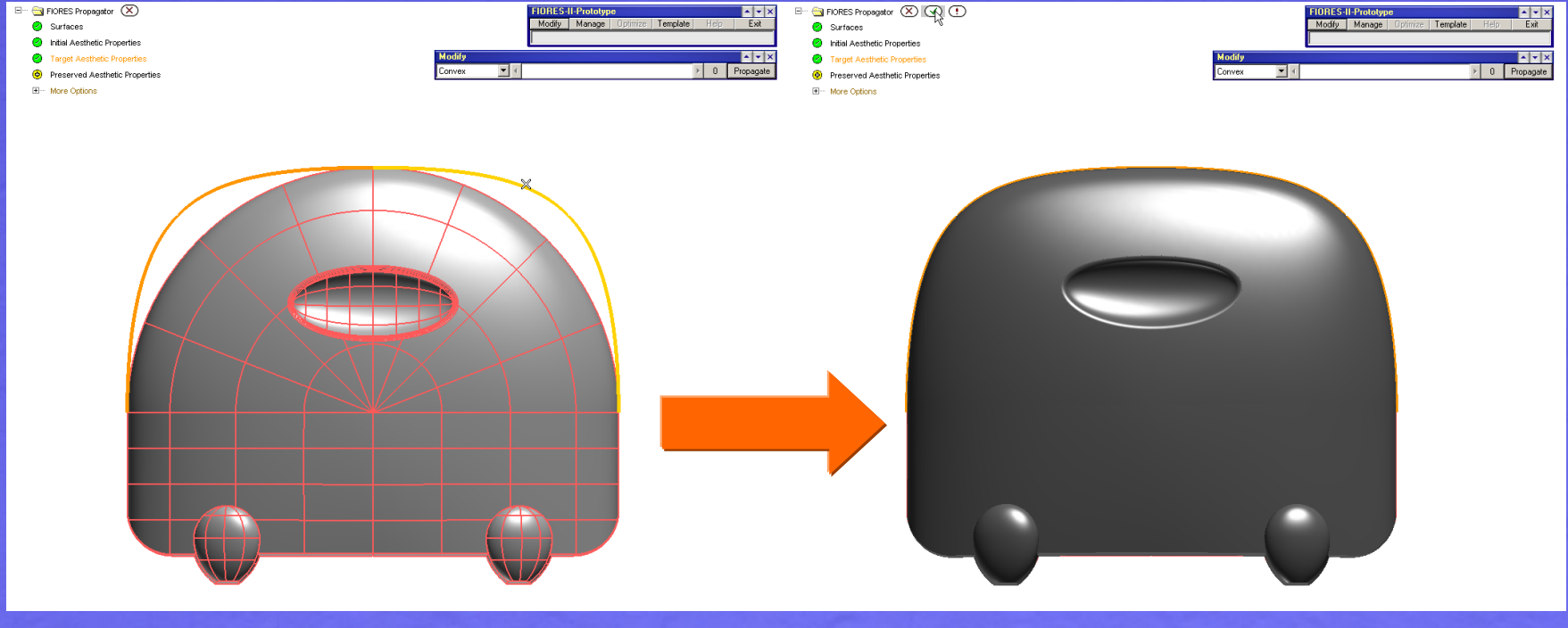


A *lead-in* is the transition of the main curves or surfaces to a *radius*

Tension



It is (up to some extent) a physical analogy with applying *tension* to a steel spline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Surfaces
Initial Aesthetic Properties
Target Aesthetic Properties
Preserved Aesthetic Properties
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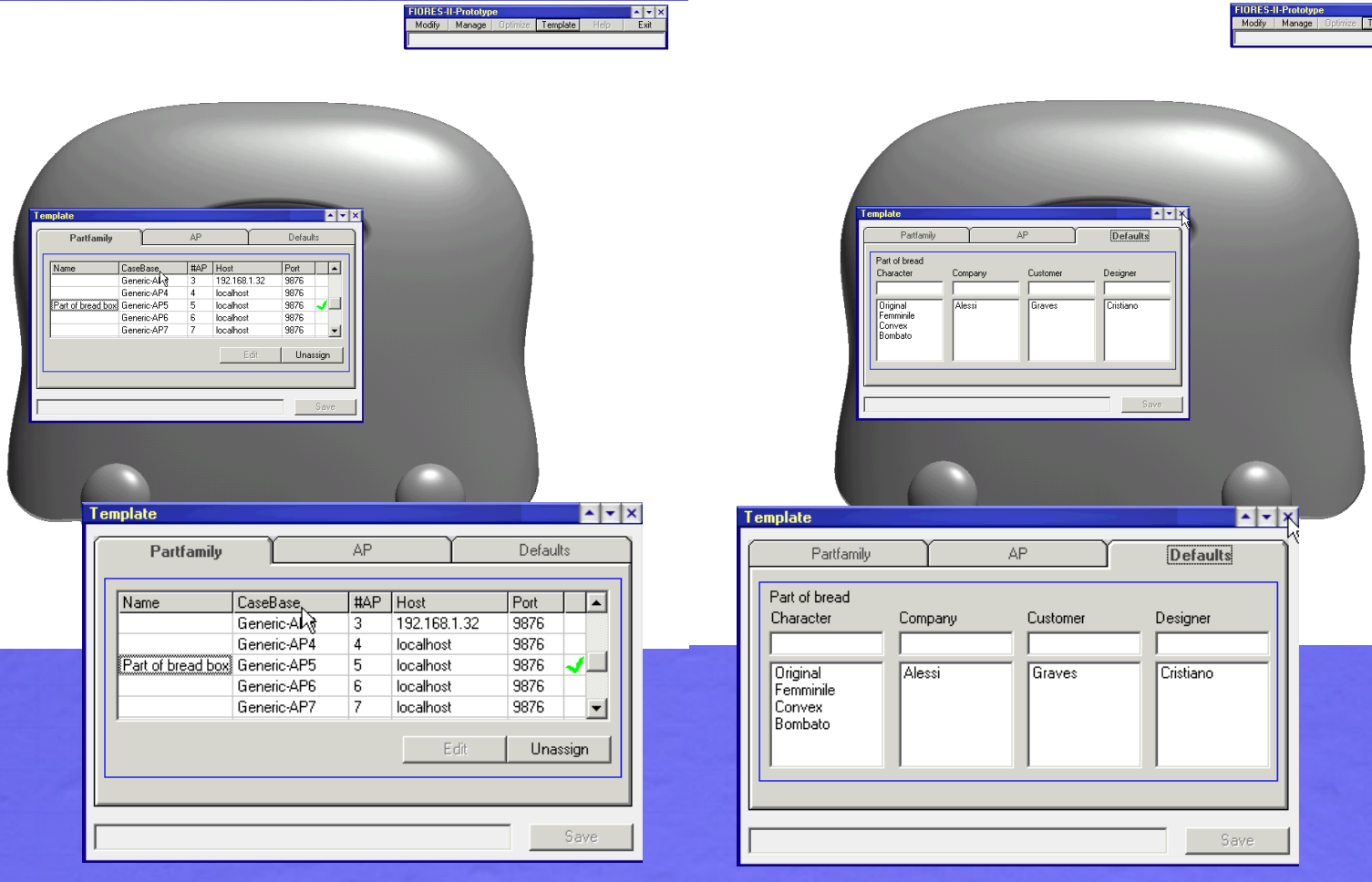
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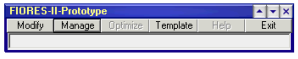
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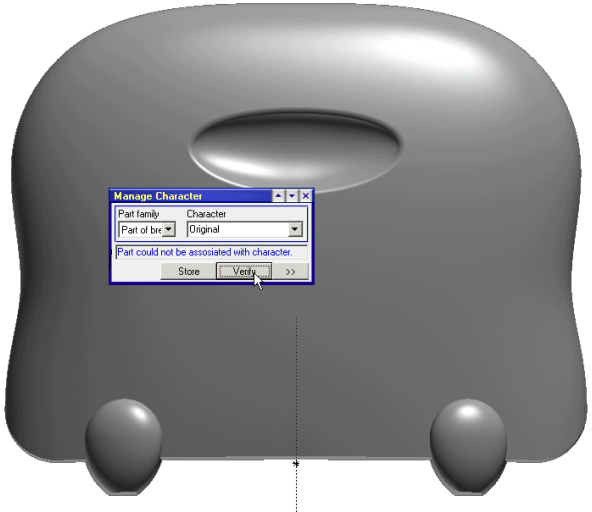
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Verify
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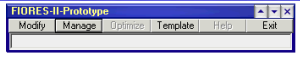
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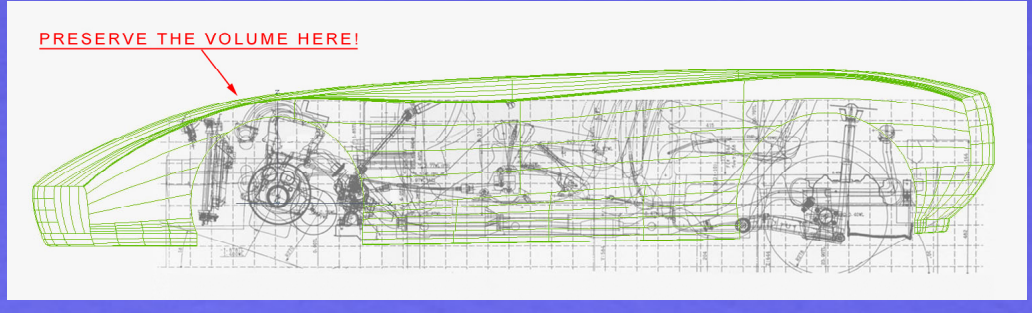
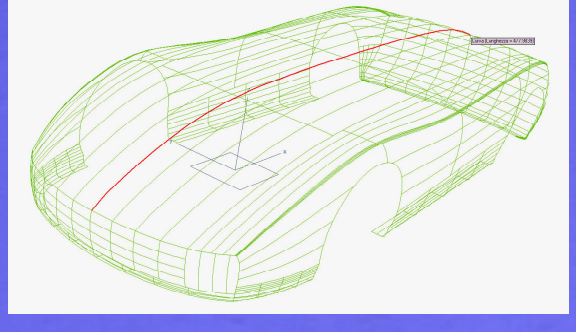
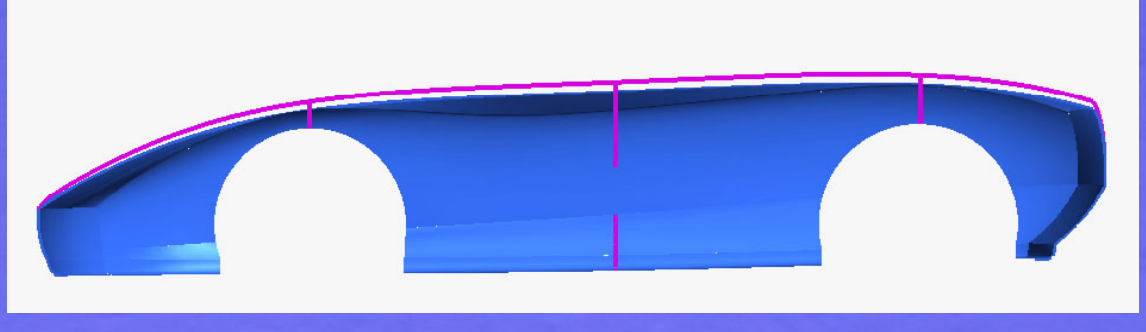
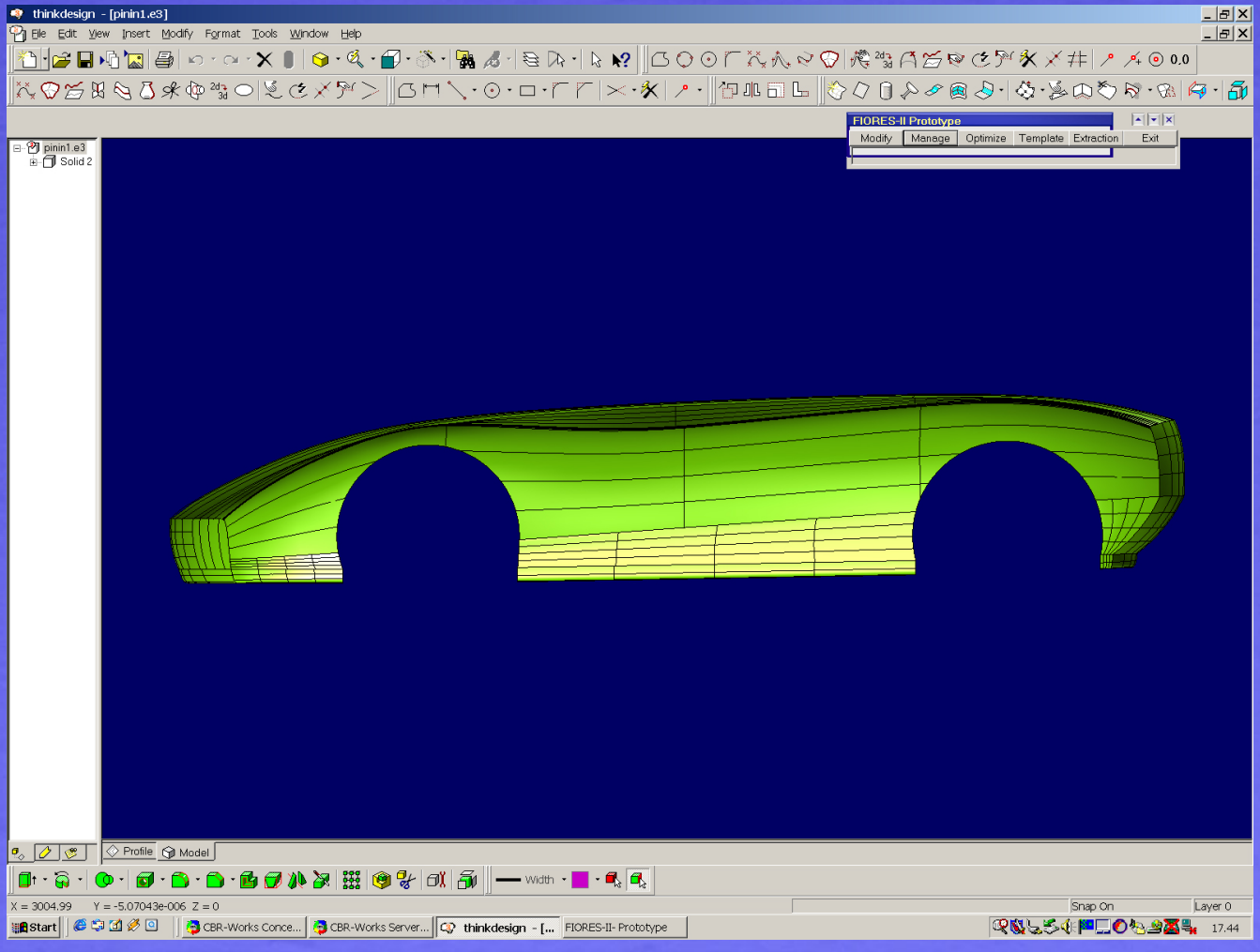

PRESERVE THE VOLUME HERE!



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pinin1.e3
Solid 2
Profile Model
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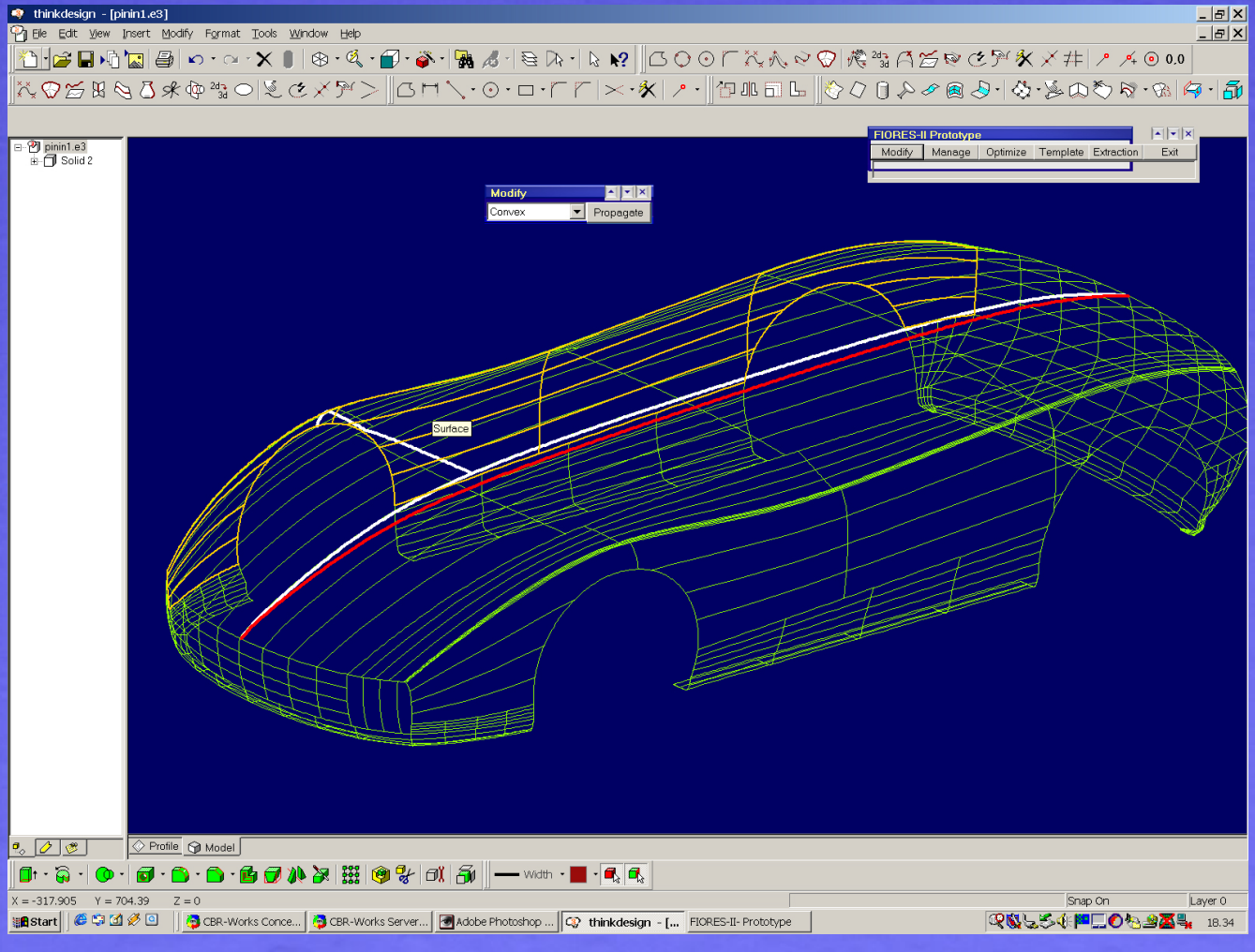
FIORES-II- Prototype
17.44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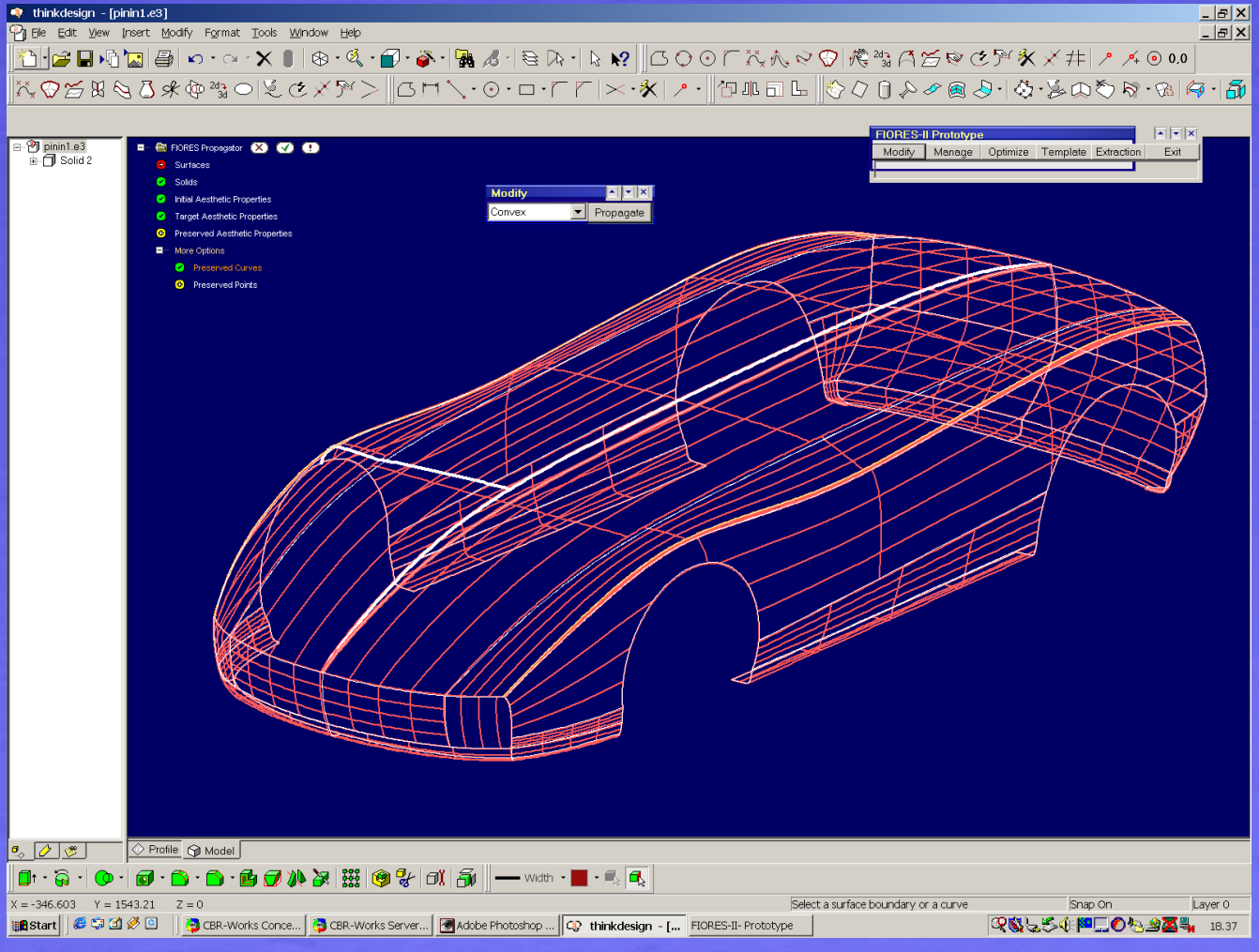
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Solid 2
FIORES Propagator
Surfaces
Solids
Initial Aesthetic Properties
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Preserved Aesthetic Properties
More Options
Preserved Curves
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Profile
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Adobe Photoshop ...
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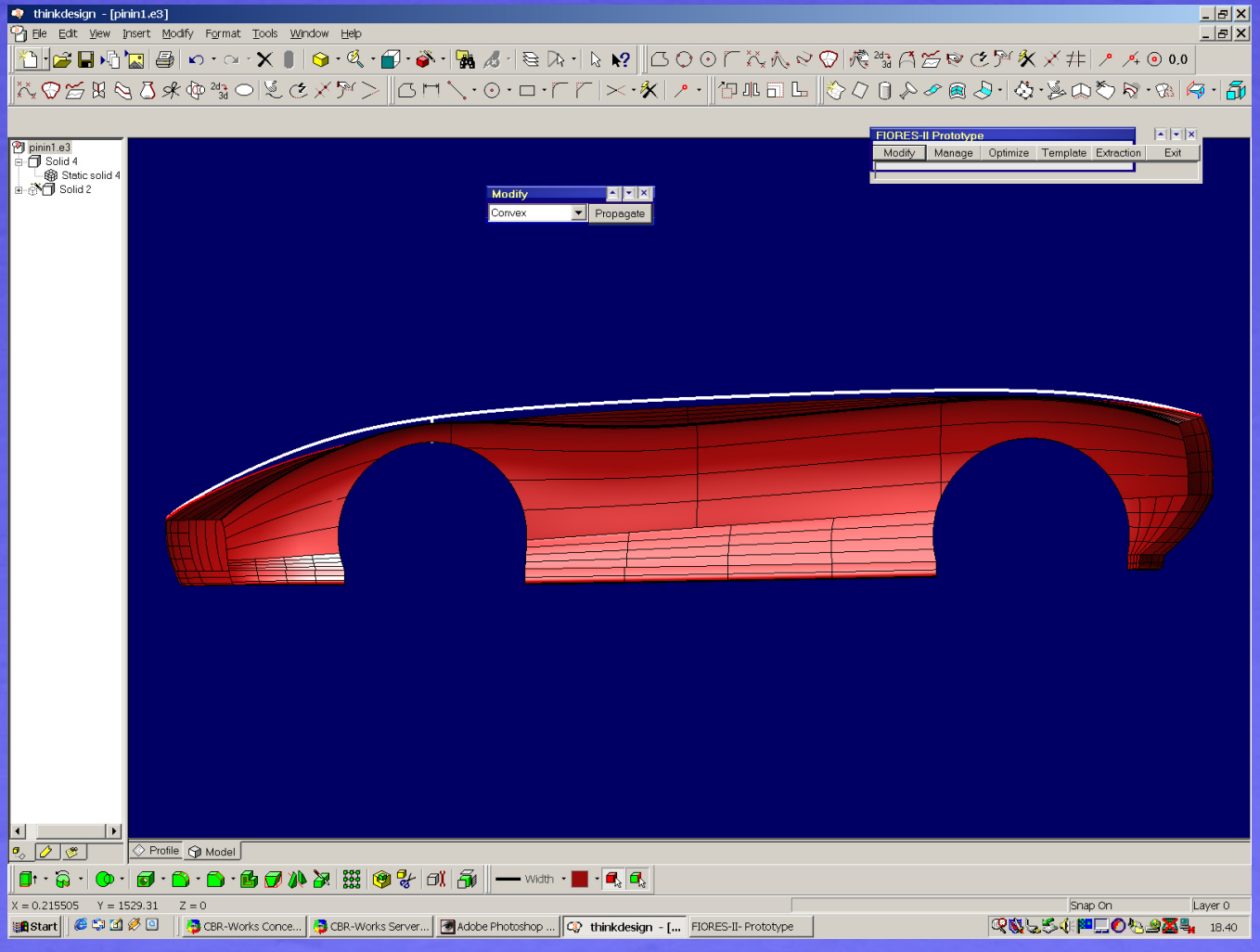
FIORES-II- Prototype
18.37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FIORES-II- Prototype
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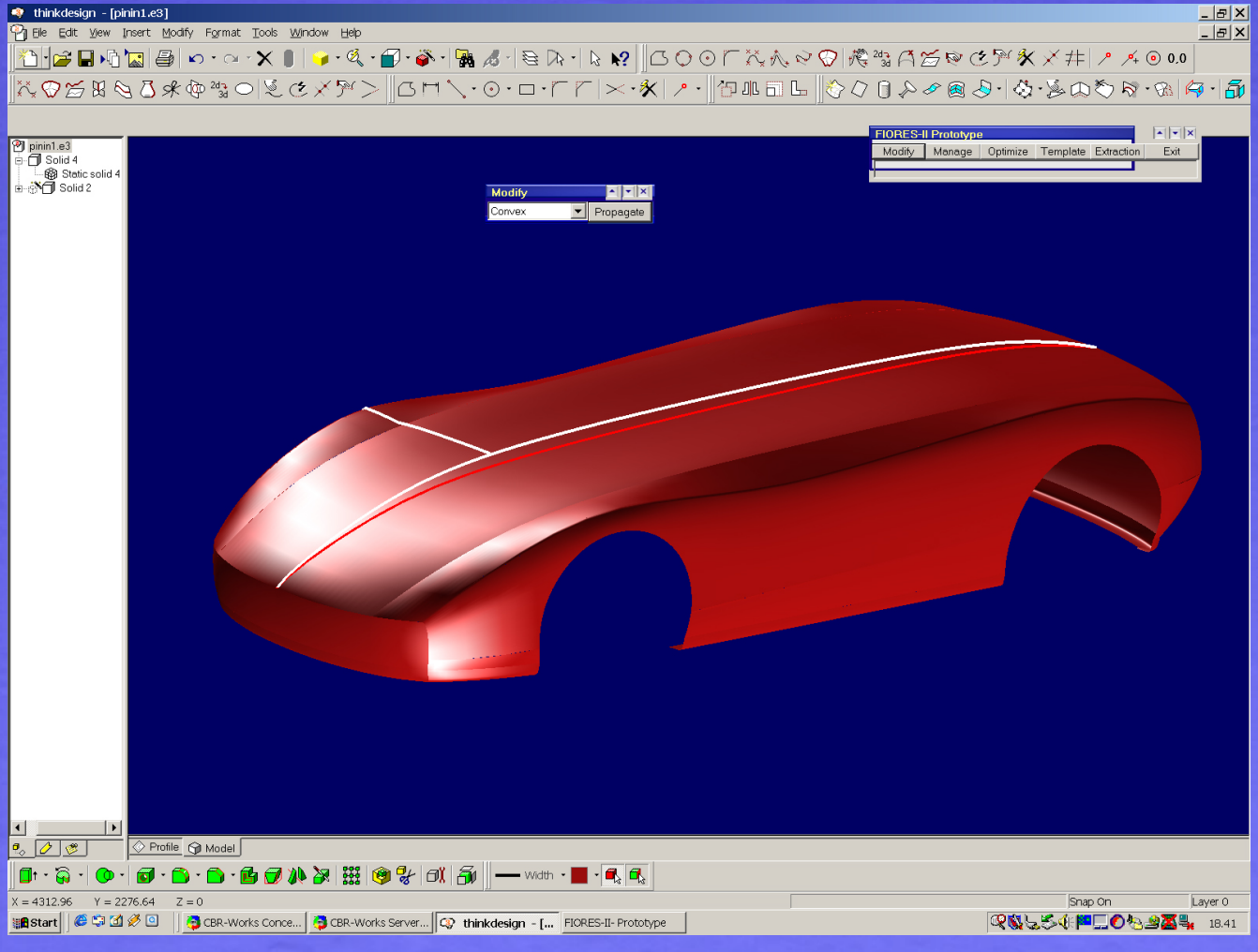
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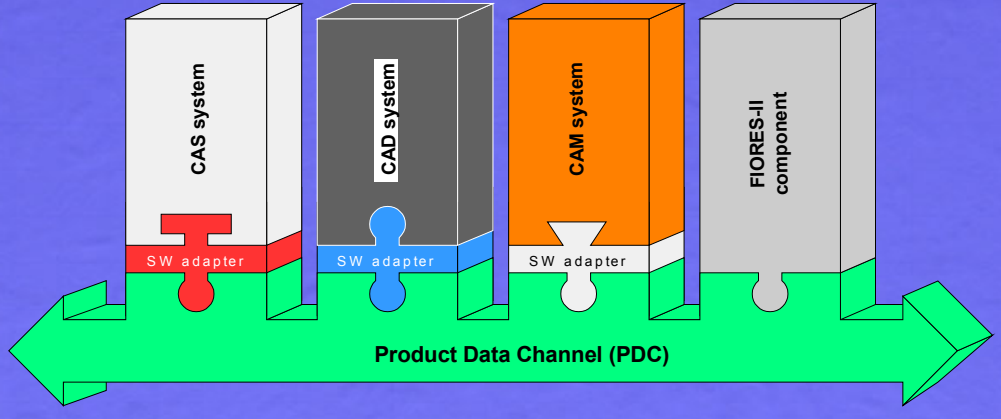
FIORES-II- Prototype
18.41

- The software prototype consists of several ***components*** operated via a common UI
  - CAGD Component
  - CBR Component
  - Design Check Component
  - Optimization Component
- Components can be connected to other CAD systems via a ***Product Data Channel (PDC)*** (Interoperability)



OUTCOMES

- A possible ***new optimized workflow***
- **Dictionary of terms** for styling
- A possible **description of the aesthetic character** by connecting formal aesthetic properties to emotional terms
- A Formalization of selected terms of designer language > ***Modifiers***
- ***Definition of modifier modelling tools*** for CA stylists (surfacers)
- An ***operational software prototype***
- ***Market***

Further Activities

- ***To spread*** FIORES results through ***publications***
- To inform the ***"Observer Group"***

Outlook

- To collect requirements for ***possible further development***
- ***To industrialize*** software components for the market
  this requires further efforts and investments