

# Discrete 3D surfaces of revolution

Final presentation

Zied BEN OTHMANE

Thomas BENOIST

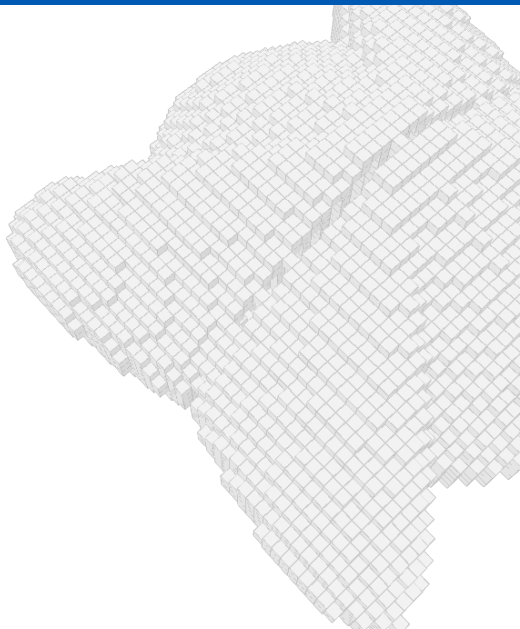
Adrien BISUTTI

Lydie RICHAUME

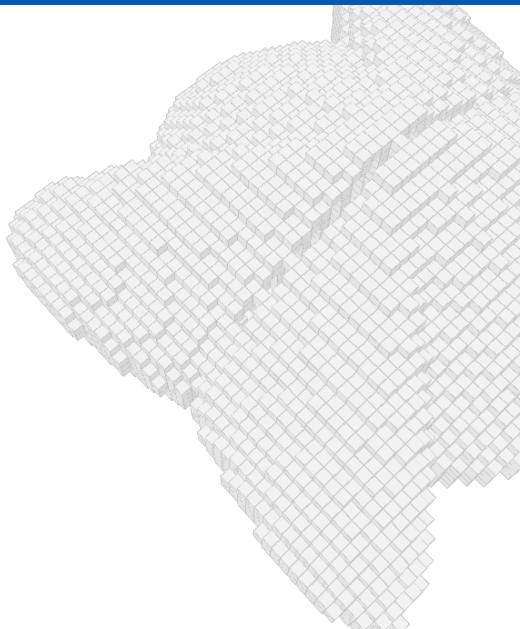
University of Poitiers

March 21<sup>st</sup>, 2016

# Outline

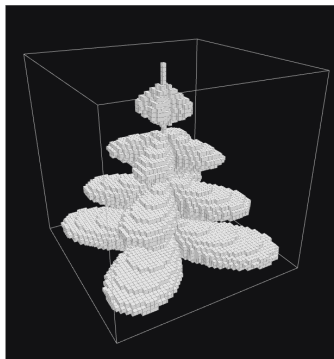
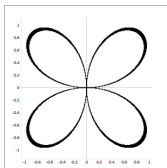
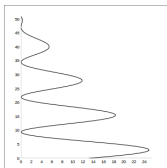


# Outline



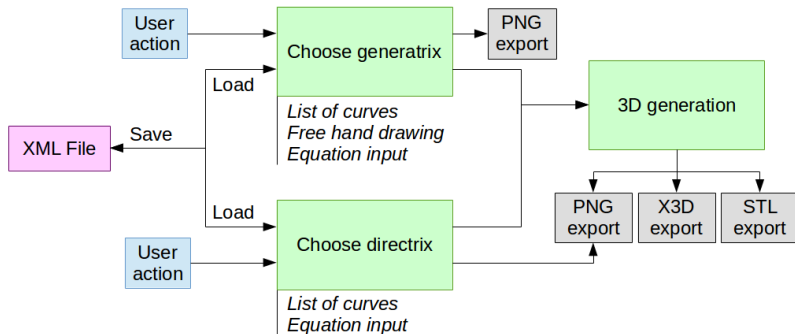
- Clients :
  - Éric ANDRES (Professor and former director of XLIM-SIC department)
  - Gaëlle LARGETEAU-SKAPIN (University lecturer, Discrete geometry)
- Exemple of final user :
  - Aurélie MOURIER (Artist)
- Pedagogic Supervisor :
  - Philippe MESEURE (Professor, Computer Graphics)

- Éric ANDRES and Gaëlle LARGETEAU-SKAPIN developed a new algorithm to model discrete surfaces of revolution.



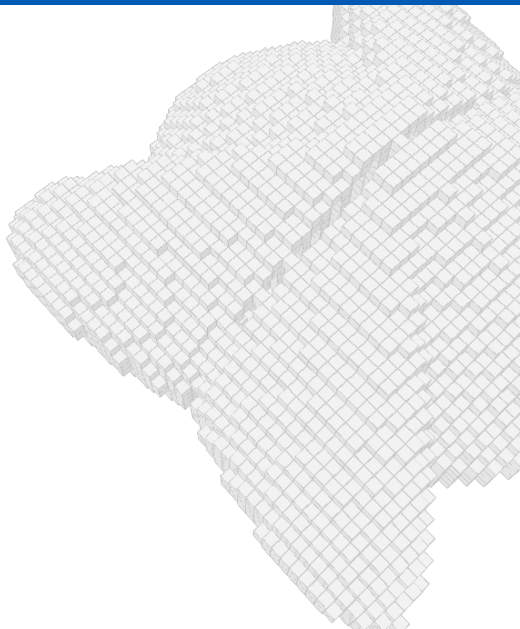
- Display the result with Mathematica
- Need a tool usable by everyone and everywhere

# Objectives



- Algorithm to generate surfaces of revolution
  - Provided by the clients
  - Possible evolution of the algorithm

# Outline

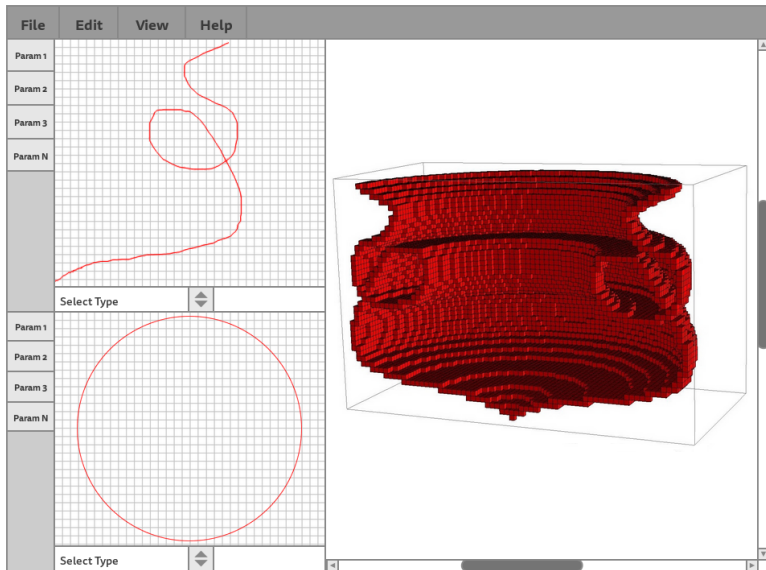


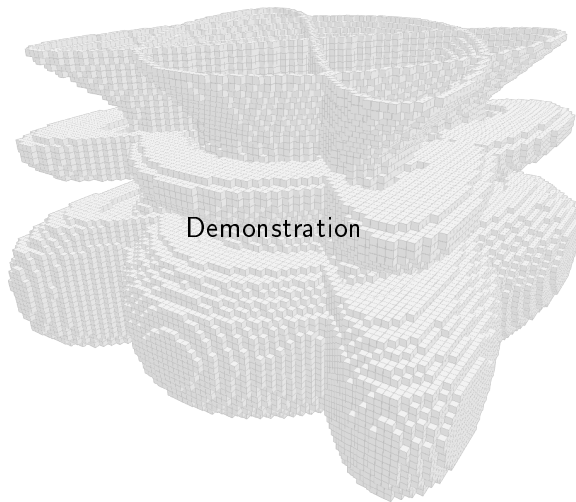
Tool usable by everyone and everywhere → web application

- Mathematica ?
  - Algorithm already implemented for Mathematica
  - Server application : difficult to set up a server from the university
  - Client application : user would have to install Mathematica (not free)
- Without Mathematica
  - Server application : security problems, data transfert
  - Client application : large quantity of computations → slow for computers with low capacities
- Choice : client application → HTML5/CSS, Javascript, WebGL



# Prototype



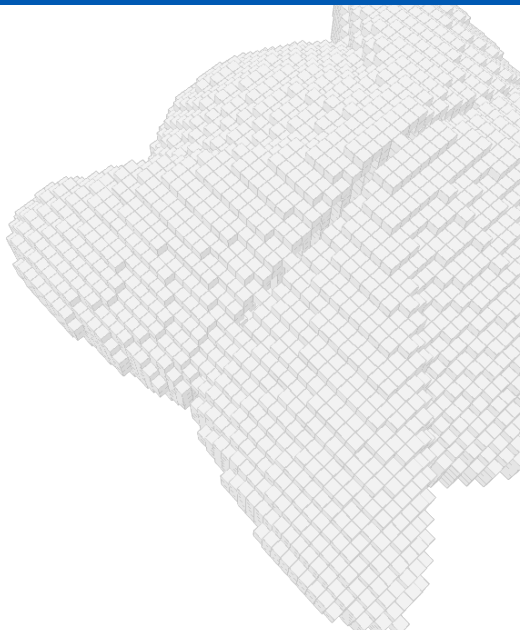


- Curves
  - Use MathJS
  - Two kind of definition : formula or freehand drawing
  - Formula : parse string  $\rightarrow$  equation
  - Freehand drawing : retrieve points from HTML5 canvas
- Display
  - Explicit curve : easy to display
  - How to display implicit curves ?
  - Use functionPlot and HTML5 canvas
  - Formula curves : functionPlot  $\rightarrow$  SVG
  - Freehand drawing : 2D rendering context on HTML5 canvas

- Generation
  - Use MathJS
  - Two versions : graph search and brute-force
  - Interactivity → generation with worker(s)
- Rendering
  - Problem : detection of the outer faces
  - First version : computation during drawing
  - Following versions : computation during generation
  - WebGL : limited buffer size → multiple buffers

- Save & load curves
  - XML format
  - Formula curves : stores the string of the equation
  - Freehand drawn curves : stores the list of points
- PNG export
  - Formula curves : saveSvgAsPng library
  - Drawn curves : FileSaver library and HTML5 canvas functionalities
- 3D export
  - X3D : transform each voxel into boxes
  - Excessive amount of boxes → slow to access
  - STL : binary file for 3D printer

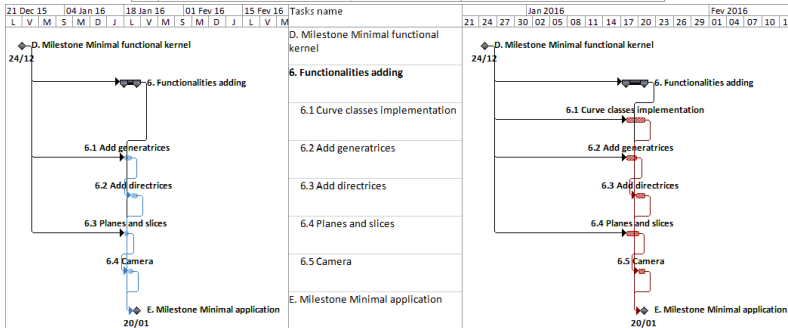
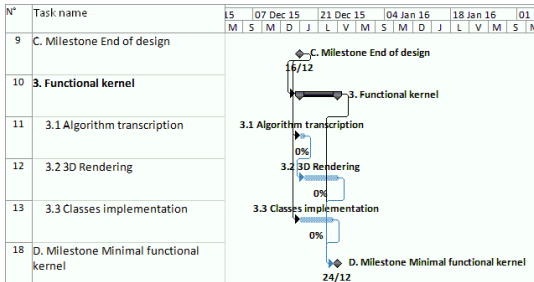
# Outline



# Task list

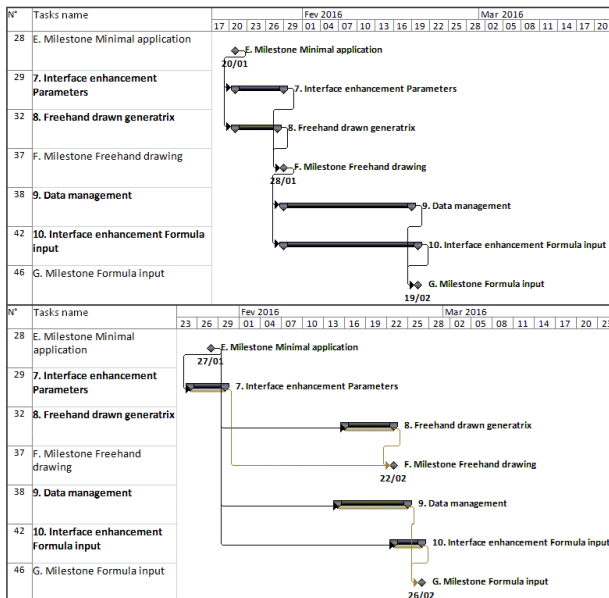
1 - Documentation, test and users help		✓	
2 - Design		✓	
3 - Functional kernel	✓	4 - Minimal interface	✓
6 - Functionalities adding	✓	5 - Interface enhancement Curve choice	✓
8 - Free hand drawn generatrix	✓	7 - Interface enhancement Parameters	✓
9 - Data management	✓	10 - Interface enhancement Formula input	✓
11 - User's curve (optional)			✗
12 - Technical report			✓

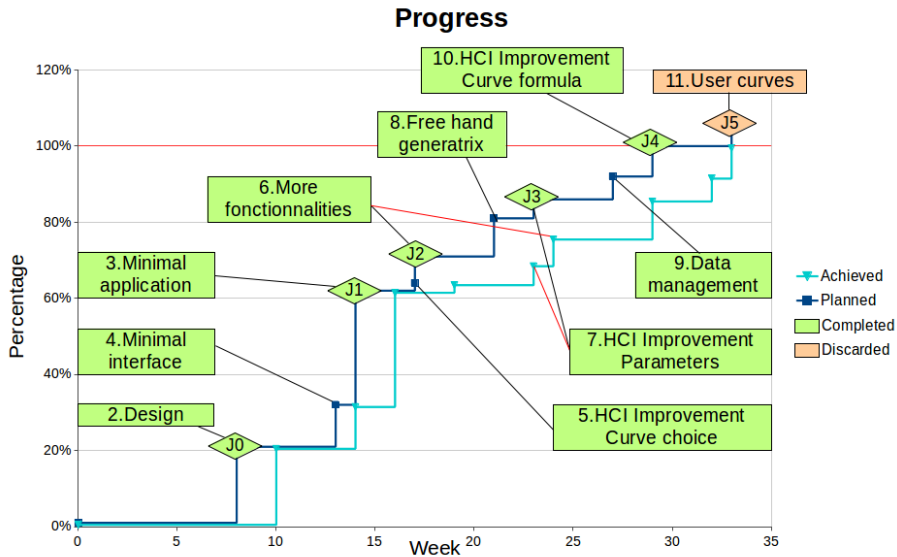
# Gantt diagram





# Gantt diagram





N°	Deliverable	Tasks	Planned date	Actual date
1	Interface and algorithm result	2, 3, 4	Dec. 23 <sup>rd</sup>	Jan. 18 <sup>th</sup>
2	Minimal application	5, 6	Jan. 21 <sup>st</sup>	Jan. 25 <sup>th</sup>
2 <sup>bis</sup>	Multi-slice and parameters	7	—	Jan. 29 <sup>th</sup>
3	Free hand drawing and curves with editable parameters	7, 8	Jan. 29 <sup>th</sup>	Feb. 24 <sup>th</sup>
4	Equations and export	9, 10	Feb. 19 <sup>th</sup>	Feb. 24 <sup>th</sup>
5	Final application <del>and documentation</del>	1 to 11	Mar. 2 <sup>nd</sup>	Mar. 2 <sup>nd</sup>
5 <sup>bis</sup>	Final documentation	1	Mar. 11 <sup>th</sup>	Mar. 14 <sup>th</sup>

# List of risks

Risk	Gravity	Probability	Criticality	
Server linked problems	1	0	0	*
New clients	1	2	1	*!
3D rendering needs too much ressources	2	1	1	*!
Evolution of the generation algorithm	1	3	2	*
Equipment/device dysfunction	1	1	1	+!
Validation reveals serious technical problem	2	1	1	*

\* Initial

+ Added

! Encountered

- Server linked problems

Gravity	0	1	2	3
Delay	●			
Costs	●			
Receipts	●			
Performance	●			
Other				
<b>Global</b>	●			

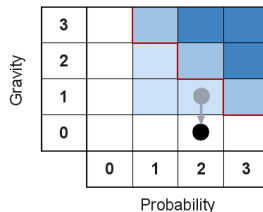
Gravity				
3				
2				
1				
0	●			
	0	1	2	3
	Probability			

Level	Gravity	Probability	Criticality
0	None	< 1%	No critical
1	Low	de 1% à 5%	
2	Important	de 5% à 20 %	Critical
3	Dangerous	> 20%	

# Risks

- New clients

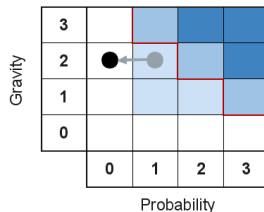
Gravity	0	1	2	3
Delay	● ← ●			
Costs	●			
Receipts	●			
Performance	● ← ●			
Other				
<b>Global</b>	● ← ●			



Level	Gravity	Probability	Criticality
0	None	< 1%	No critical
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- Slow rendering

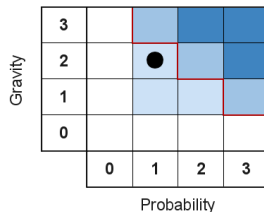
Gravity	0	1	2	3
Delay			●	
Costs	●			
Receipts	●			
Performance			●	
Other				
<b>Global</b>			●	



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- Evolution of the generation algorithm

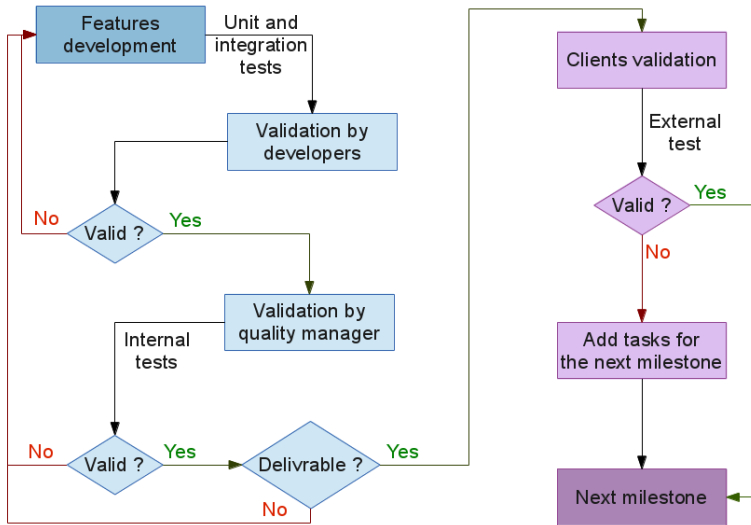
Gravity	0	1	2	3
Delay	●			
Costs	●			
Receipts	●			
Performance			●	
Other				
<b>Global</b>			●	

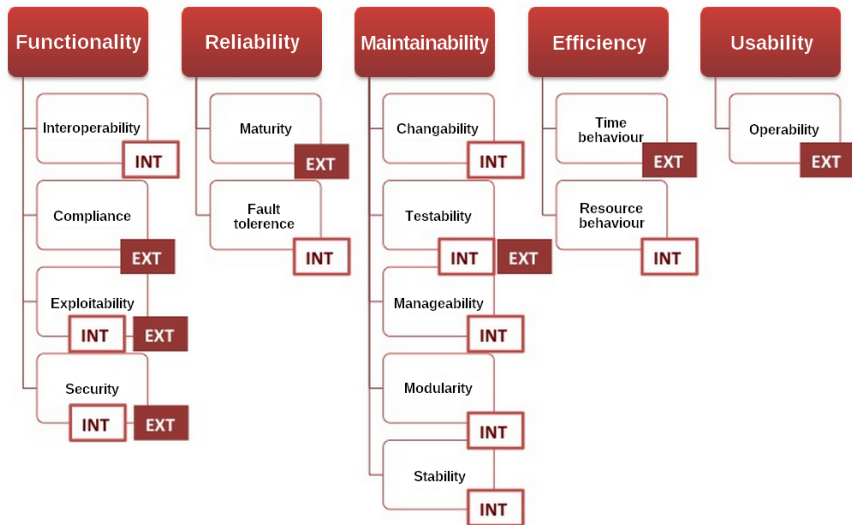


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0	None	< 1%	No critical
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3	Dangerous	> 20%	



# Quality insurance plan



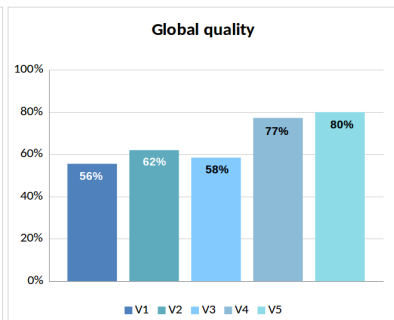
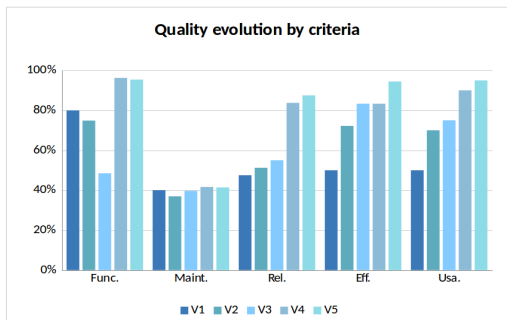


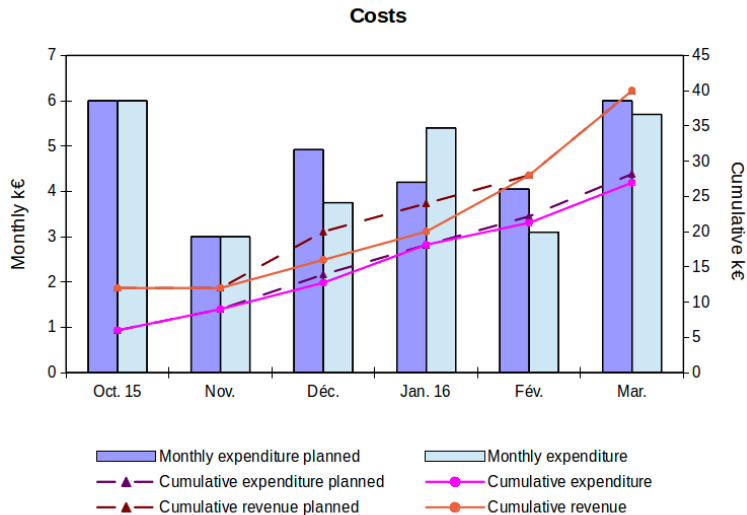
# Software quality measurement

1	Question	Version 5
1	Overall vision	1
2	The ease to find the information	1
3	Response speed	1
4	Utility of the information	1
5	The choice of title and heading and their meanings	1
6	The completeness of the information found against the need	1
7	Execution speed	1
8	Errors rate	1
9	Handling the use	0.5
10	The reliability of the application	1
	Total	95%

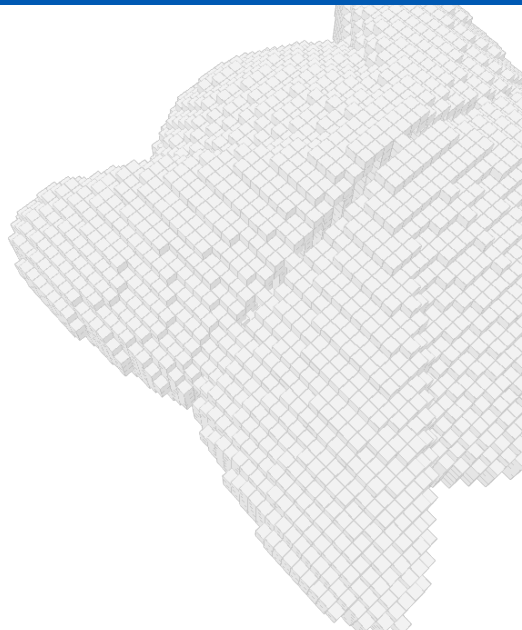
1	Functionality	Version 5	
		Int	Ext
1	Interoperability		
Goal	Ability to interact with one or more systems		
Question	Is the application uses norms and technical standards?		
Evaluation		95.83%	
1	Adequacy		
Goal	Checking the adequacy of spots against the needs		
Question	Does each function is adequate to the customer need?		
Evaluation			90%
0.5	Operability		
Goal	The ability to properly use the software system		
Question	At what level the software is usable?		
Evaluation			100%
	Note I/E	95.83%	95%
	Functionality	95.41%	

# Software quality evaluation





# Outline



- Clients satisfied by the application
- Application available on XLIM website
- All main functionalities developed
- Final deliverable in two stage
- Possible improvements
  - X3D export
  - More information for users
  - More types of curve
- Perspectives
  - New algorithms
  - Lydie's internship subject

- Weekly meetings with the pedagogic supervisor
- Interactions with clients
- Example of quality insurance plan
- Planning management
- Risks encountered



- Improvement in Javascript
  - classes, inheritance, worker, etc.
  - jQuery, MathJS, FileSaver
  - WebGL
- Spiral development : new experience
- Solving mathematical problem
  - base matrices
  - drawing implicit curves
  - etc.

# Discrete 3D surfaces of revolution

Final presentation

Thanks for your attention.

Are there any questions ?