TopSolid Project

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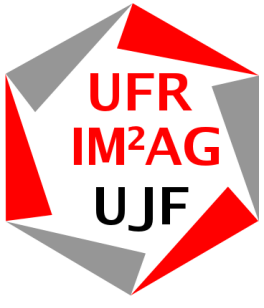

Plan

Figure : TopSolid Galaxy

- First CAD/CAM solution on PC's in the 80's.
  200 people, international resellers and around 25M of turnover.
- TopSolid products :
  - General CAD/CAM : Modeling, assembly, kinematic, drafting. Turning, milling.
  - Tooling CAD/CAM : Mold design, progressive, transfer and stamping die design. EDM.
  - Sheet metal CAD/CAM : Sheet metal design, flat pattern computation. Punching and cutting.

- Punch die.
- Blank holder.
- Metal strip.
- Die holder.

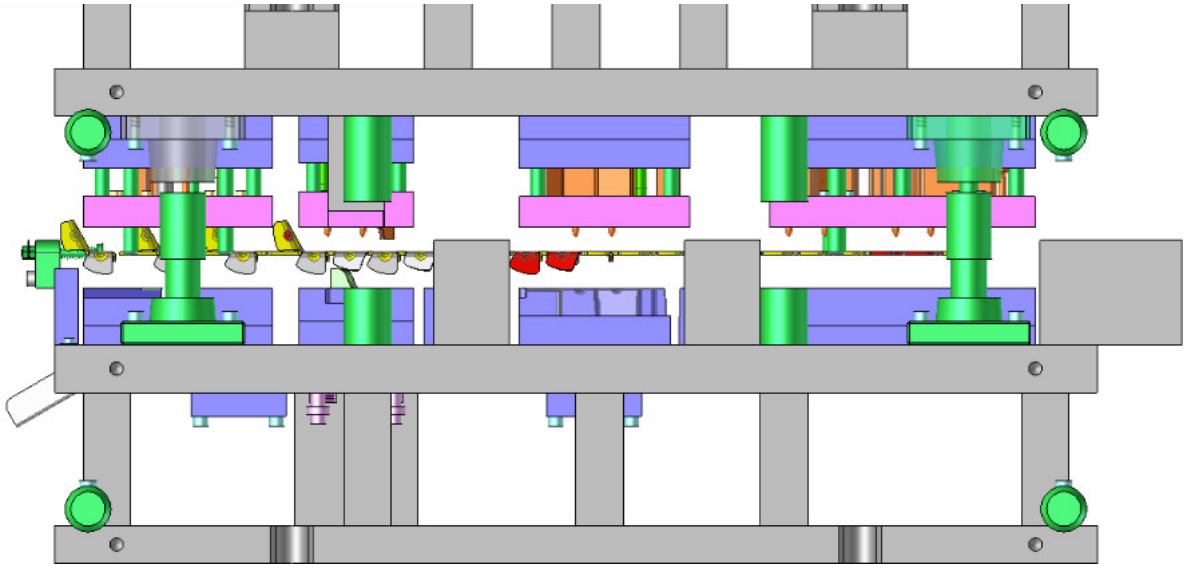

Figure : Progressive die tool

- Cutting :
  Takes some parts of the initial material off.
- Bending :
  Creation of a formed feature by angular displacement of a sheet metal workpiece.
- Stamping :
  Change the shape of the initial material by pushing it strongly.

Plan

Bending simulation module

For specific productions in connector industry, the bending process needs to be simulated accurately in order to :

- Compute non intuitive trajectories of the free parts of the metal sheet during multiple bending process.
- Evaluate the spring back movement.

- Bending simulation add-in.
- 2D representation.
- Sheet metal part geometry : constant thickness.
- Various punch die and punch holder shapes.
- Various material characteristics.

A 2D representation of :

- **A die holder** : A polygon which does not move over the time.
- **A blank holder** : A polygon that comes to fix a part of the metal sheet.
- **A punch die** : A polygon that we know the position over the time.
- **A metal strip** : With its fixed thickness, it is described by its neutral axis with well known characteristics.

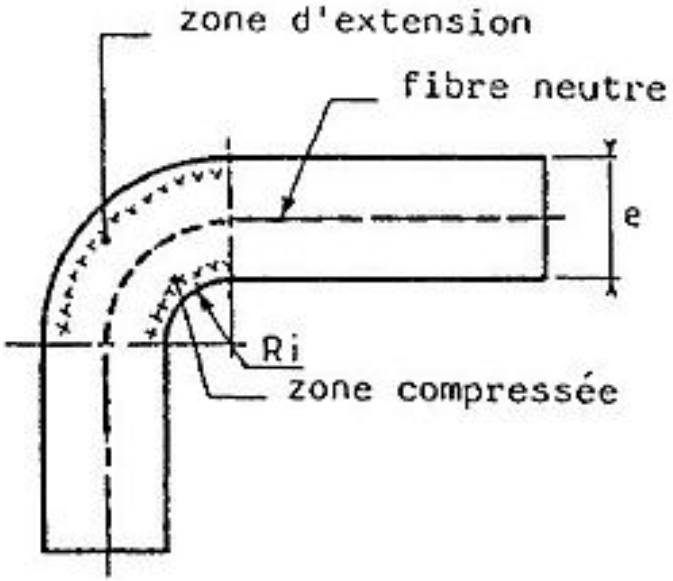

Figure : Neutral axis

In order to have a realistic representation of the bending process we will cut the problem into two parts :

1. XML scene representation containing :
   - Static parts geometry and position.
   - The material characteristics.
   - The boundary conditions.
   - The punch die geometry and position at every step.
2. A finite element solver using Open fem :
   - Takes a step disposition and strengths applied to the metal sheet.
   - Return the new metal sheet shape.

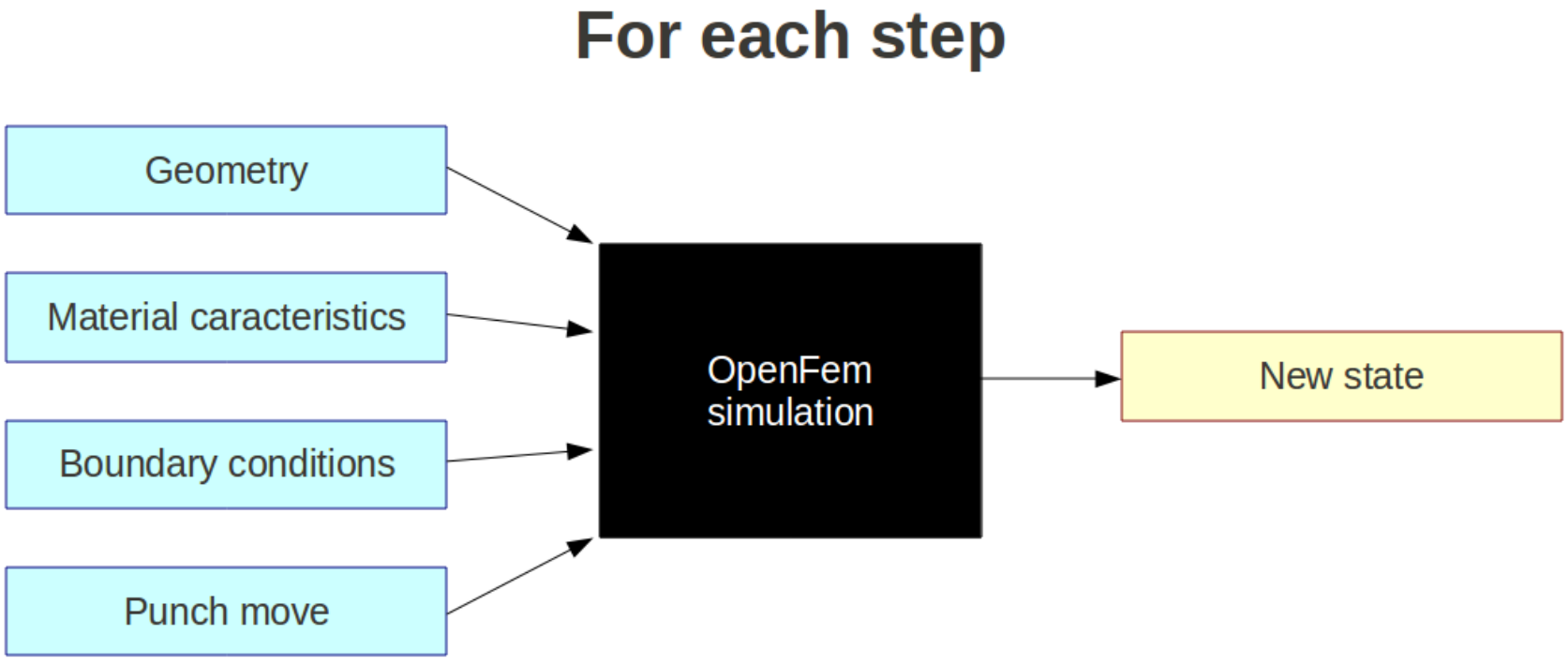

Figure : Dialog between Open fem and internal scene representation

In a one operation cycle we will allow the user to :

- Define the system's initial state.
- Indicate the simulation's parameters.
- Visualize all the simulation steps.
- Visualize the trajectories of the free parts of the metal sheet.
- Visualize the distance between two points at a given step.
- Follow a given point over the time.

Figure : The graphical user interface

Plan

Gantt diagram

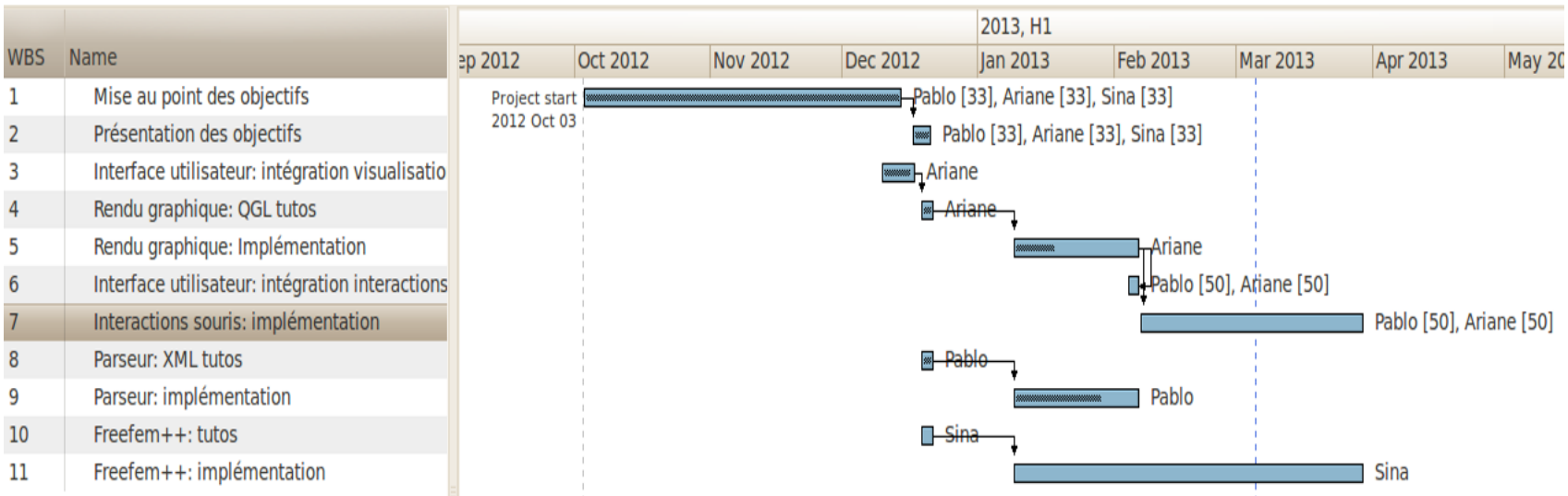

Figure : Gantt Diagram

- MCS : handles open fem
  Compute the metal sheet's deformation at every step.
- ICAO : visual rendering.
  Graphical user interface and interaction.
- ICAO : XML scene description and parser.
  Communication with open fem.

Tasks repartition

Name	Task
Miladi	
Miladi	Mise au point des objectifs
Miladi	Présentation des objectifs
Miladi	Freefem++: tutos
Miladi	Freefem++: implémentation
Lefebvre	
Lefebvre	Mise au point des objectifs
Lefebvre	Présentation des objectifs
Lefebvre	Interface utilisateur: intégration visualisation
Lefebvre	Rendu graphique: QGL tutos
Lefebvre	Rendu graphique: Implémentation
Lefebvre	Interface utilisateur: intégration interactions souris
Lefebvre	Interactions souris: implémentation
Coves	
Coves	Mise au point des objectifs
Coves	Présentation des objectifs
Coves	Interface utilisateur: intégration interactions souris
Coves	Interactions souris: implémentation
Coves	Parseur: XML tutos
Coves	Parseur: implémentation

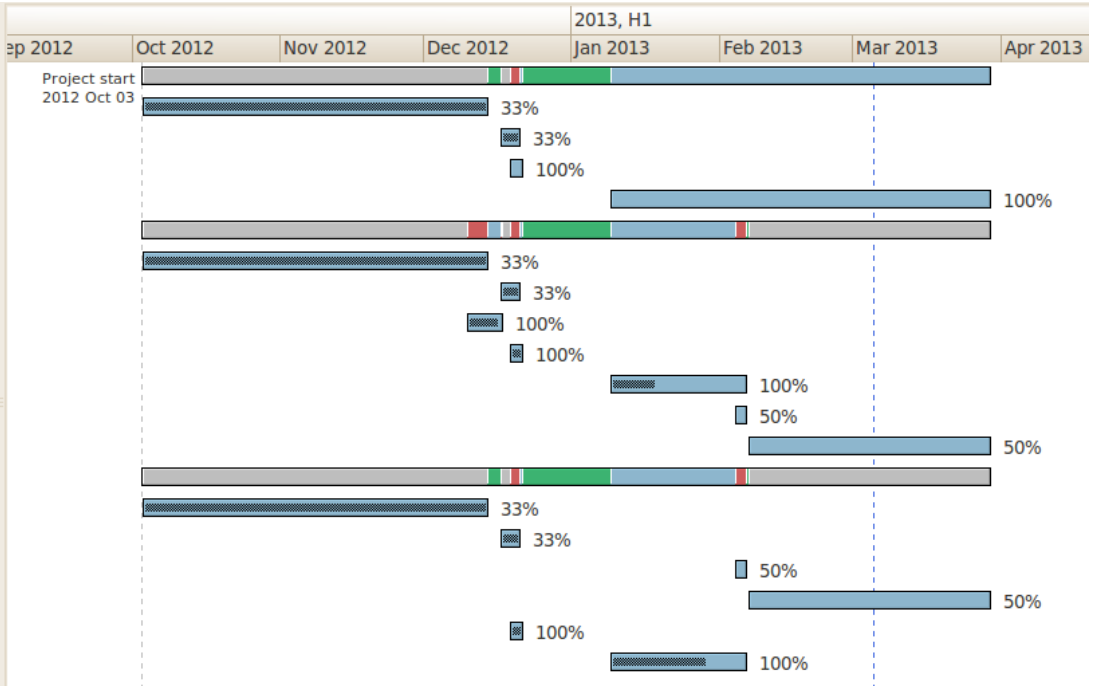

Figure : Tasks repartition

WBS	Name	Start	Finish	Work	Duration	Slack	Cost	Assigned to	% Complete
1	Mise au point des objectifs	Oct 3	Dec 14	52d	52d 3h	70d 3h	0	Pablo, Ariane, Sina	100
2	Présentation des objectifs	Dec 17	Dec 21	4d	4d	70d 6h	0	Pablo, Ariane, Sina	100
3	Interface utilisateur: intégration visualisation	Dec 10	Dec 17	6d	6d	13d	0	Ariane	90
4	Rendu graphique: QGL tutos	Dec 19	Dec 21	3d	3d	10d	0	Ariane	100
5	Rendu graphique: Implémentation	Jan 9	Feb 6	21d	21d		0	Ariane	33
6	Interface utilisateur: intégration interactions souris	Feb 4	Feb 6	3d	3d		0	Pablo, Ariane	0
7	Interactions souris: implémentation	Feb 7	Mar 29	37d	37d		0	Pablo, Ariane	0
8	Parseur: XML tutos	Dec 19	Dec 21	3d	3d	49d	0	Pablo	100
9	Parseur: implémentation	Jan 9	Feb 6	21d	21d	37d	0	Pablo	70
10	Freefem++: tutos	Dec 19	Dec 21	3d	3d	12d	0	Sina	0
11	Freefem++: implémentation	Jan 9	Mar 29	58d	58d		0	Sina	0

Figure : Tasks completion

Plan

- Take sheet metal thickness modification into account.
- Evaluate spring back compensation to modify punch and die geometries.

Thank you for your attention.

Any questions ?