TopSolid Project

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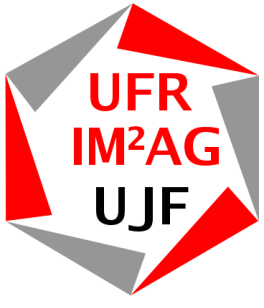

Plan

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.

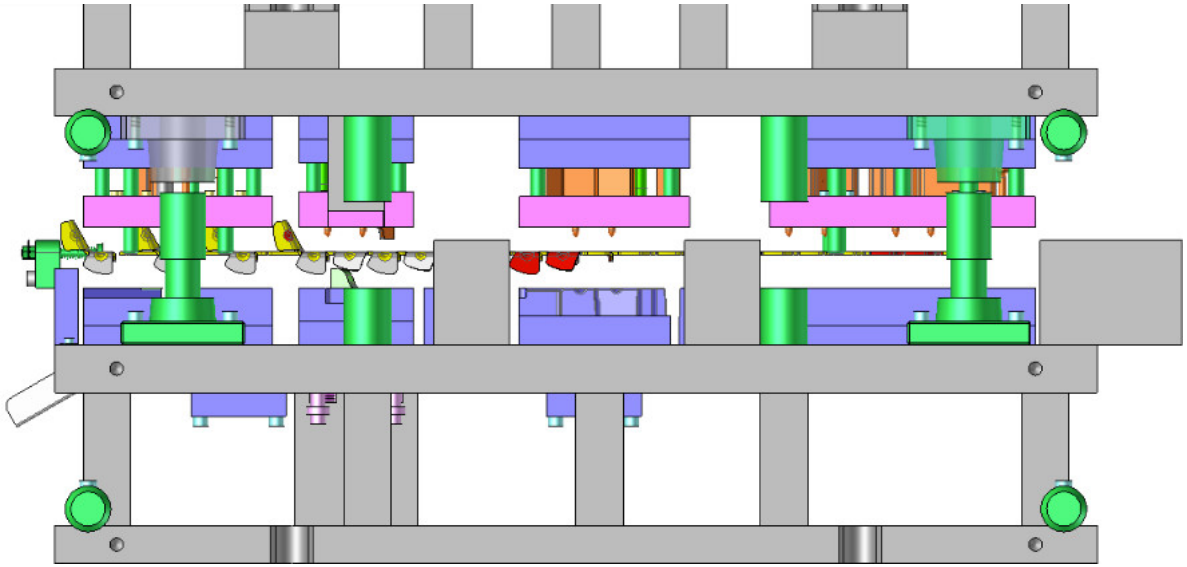

Figure : Progressive die tool

- 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.

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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.

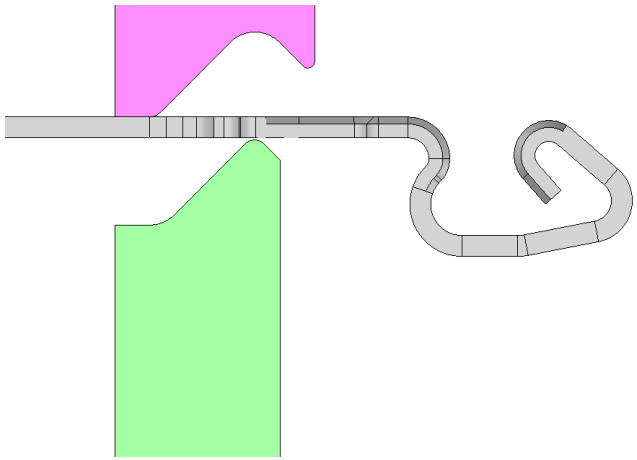

Figure : A 2D representation

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.

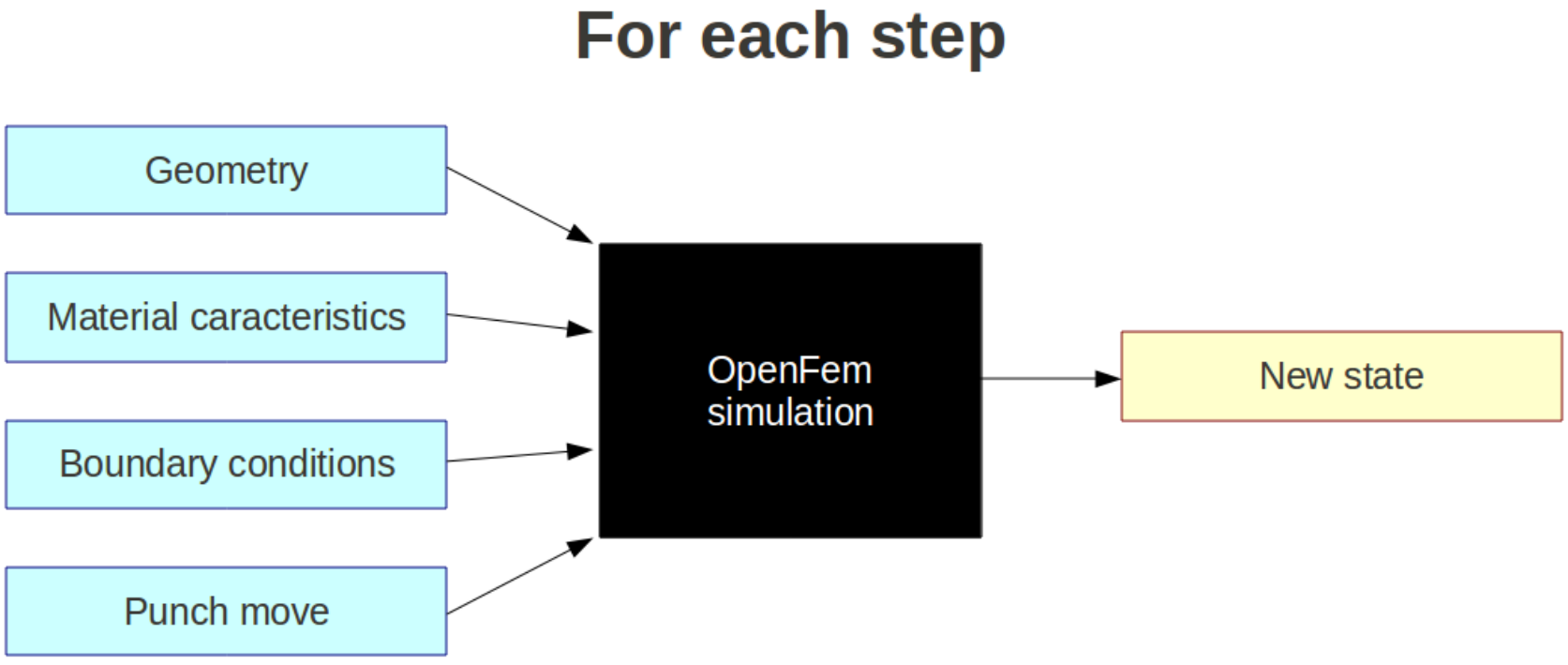

Figure : Dialog between Open fem and internal scene representation

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

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Gantt diagram

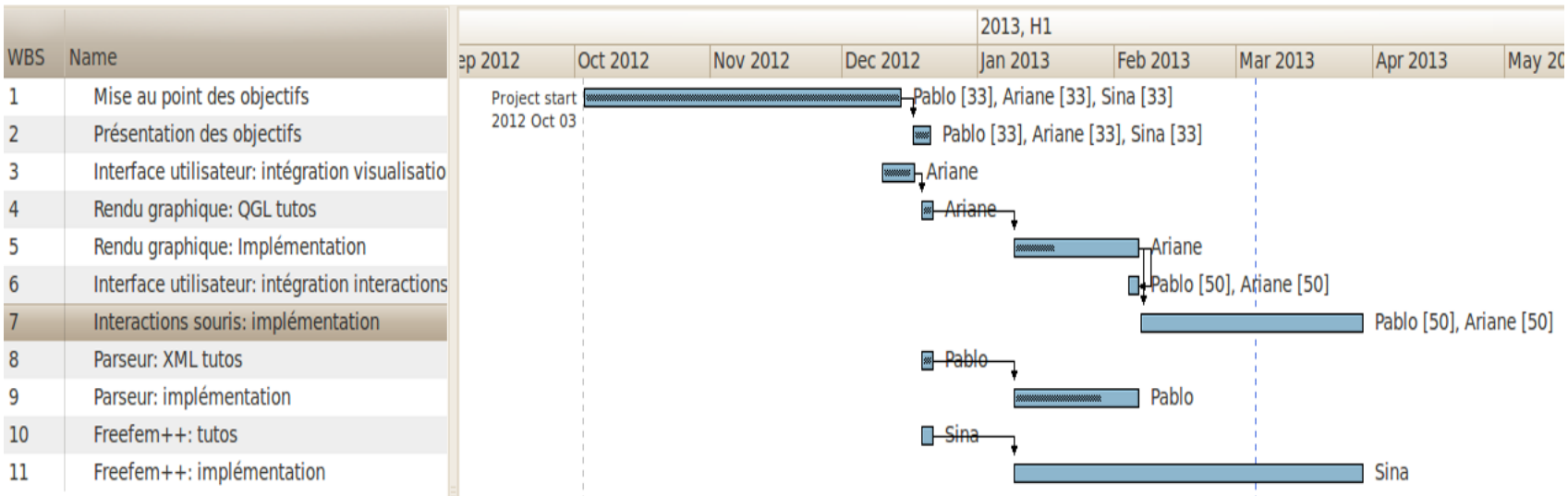

Figure : Gantt Diagram

- 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

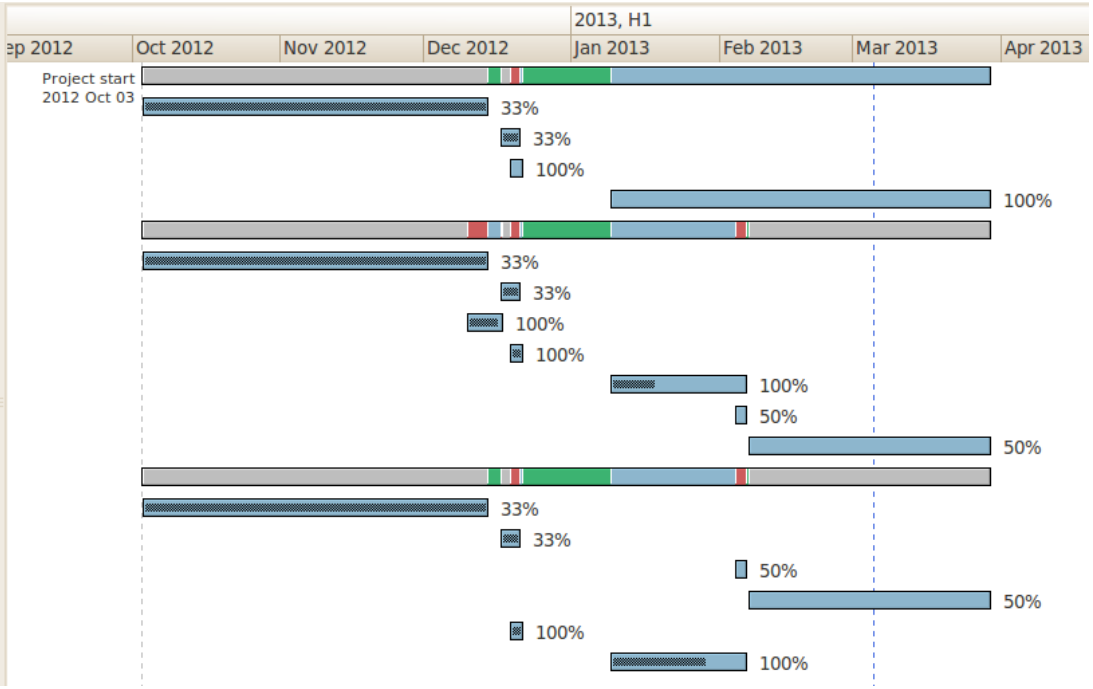

Figure : Tasks repartition

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 ?