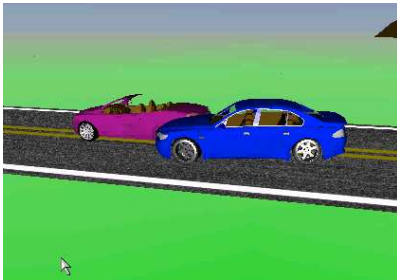


Sherpa Engineering has been involved in projects related to the vehicle dynamic domain since its creation. We have worked with car manufactures, like PSA and Renault, for many years as well as with key actors in the submarine and truck sectors.

The foundations of our success are:

- An efficient framework
- The capitalization of our experience in our “PhiSim Vehicle Dynamic” tool



View of a 3D representation in Phisim

## FRAMEWORK AND METHODOLOGY

Our methodology is based on the Bond Graph modeling framework and on the System Engineering processes. Our methodology is composed of several steps:

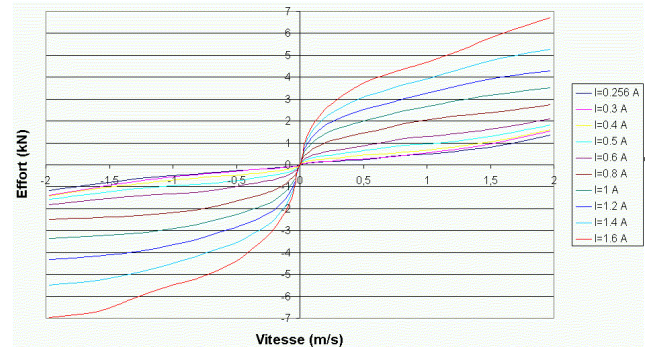
1. Processes and management
2. Needs analysis and system requirements
3. Systemic modeling
4. Design and dimensioning based on different physical system models
5. Performance analysis and optimization
6. Integration, testing, validation and qualification

## ACTIVITIES

### System and component dimensioning

- Functional specifications of hydraulic and mechanical components
- Tool development for dimensioning support
- Dimensioning of braking and power steering components

**Example:** Dimensioning of damping and suspension system



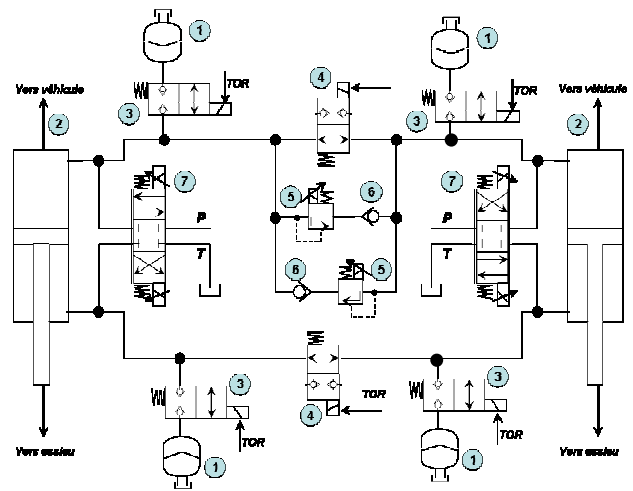
Damping dimensioning

## Innovative systems design

Our studies are particularly relevant in the design and R&D phases when the control system and the components of the system are firstly modeled and eventually prototyped.

**Examples:**

- Electrical mastervac
- Wireless steering
- Design of an hydraulic circuit for an active suspension system



Hydraulic circuit of an active suspension

## Control system design

The control system takes action in both, high level (full chassis control) and low level (actuator control)

**Examples :**

- High level control for a semi active suspension
- Low level control for ABS/ESP block electro-valves (pressure regulation)

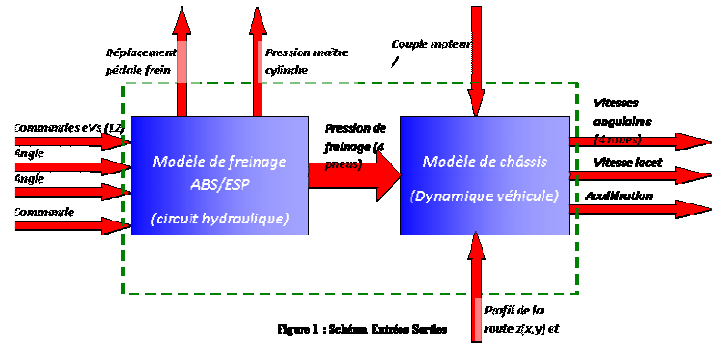
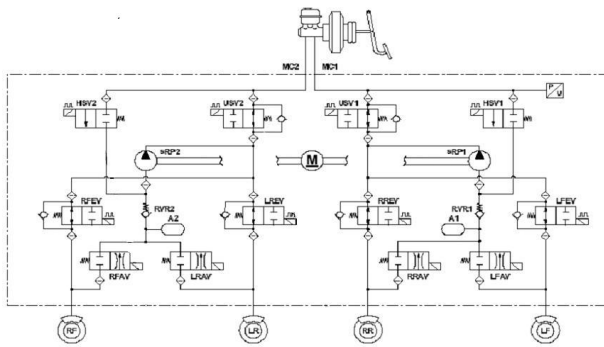
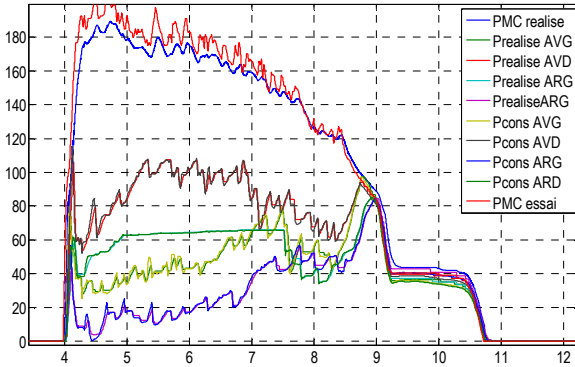


Figure 1 : Schéma Externe Series



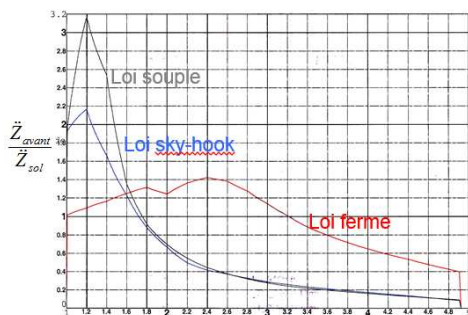
ABS hydraulic and pressure regulation circuit

### Control system validation

Integration, checking, validation and qualification activities are essential in the system development process. They imply testing the system in real mode or by simulating it:

- o Real mode : tests specifications, realization and analysis
- o Simulation mode : MIL (Model In the Loop) and HIL (Hardware In the Loop) tests

**Example :** This curve represents the frequency response for a suspension system. The control system aims at a compromise between the comfort and the road handing



**Example :** This diagram represents the HIL model of a vehicle and a braking system for ABS/ESP calculator validation

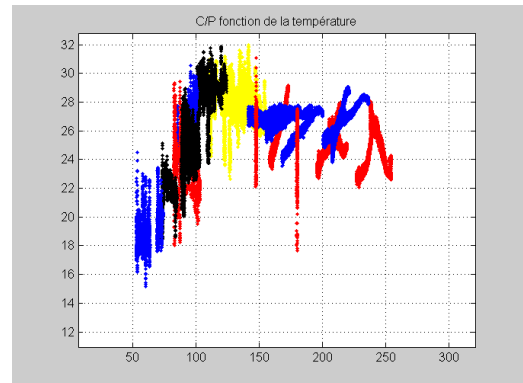
### Modeling/Simulation

Our methodology is composed of several steps:

1. Modeling level definition
2. Choice of the most suitable software tool
3. Functional tests using the model
4. System validation (with or without control system)

### Example :

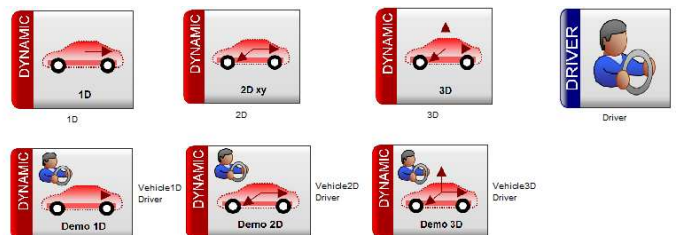
Hydrodynamic submarine engine. This graph represents the results of a study on braking effectiveness



Essais Efficacité frein=f(température)

### TOOLS

We design our models in different environments, using mainly PhiSim, Simulink and AMESim solutions. Our experience is capitalized in a library, the "Phisim Vehicle Dynamic" library, which is available for our customers. This library includes 2D/3D vehicle models, driver modules and vehicle environment modules.



PhiSim Vehicle Library