PhD SCHOLARSHIP 2018 DATASHEET

Business Division Business Area	Industry and Transport Automotive
Technology Platform	Lightweight structures
Scholarship location County/Province Building	C/ Geldo, Edificio 700 Parque Científico y Tecnológico de Bizkaia, E-48160 Derio Bizkaia

SCHOLARSHIP DESCRIPTION

Scholarship title:

Development of a multiscale modelling approach to predict AHSS steel failure in stamping/deep drawing processes for the automotive sector

Brief description of scholarship:

For several years, the automotive sector companies face the need to develop lighter vehicles to reduce fuel consumption and CO_2 emissions, without generating an impact on safety. Recently, Advanced High-Strength Steel (AHSS) have been launched to the market to address those needs. These steels have excellent mechanical properties and a good strength/ductility balance mainly due to their complex microstructures: a combination of multi phases such as ferrite, martensite, bainite and retained austenite. However, there are also disadvantages. AHSS steels present problems in the cold sheet metal forming process. This is due to premature tool breakage, elastic recovery deviation known as springback and the formation of unexpected fractures. This prevents AHSS extensive use in the automotive sector. The project including this PhD scholarship intends to solve these problems which are currently so relevant for the automotive sector companies.

Detailed description of scholarship:

As we know, the future of the automotive industry is based on increasing vehicle sustainability, which in turn demands reducing gas emissions and fuel consumption. Today, the automotive sector accounts for 15% of CO2 emissions and has to comply with European standards such as Euro 5 and Euro 6. These standards set an emission limit below 100 g CO_2/km (75 g CO_2/km in 2025). In addition to the above, the new Worldwide Harmonised Light Vehicle Test Procedure (WLTP) constitutes another step towards providing consumption and emission standards which are more realistic and according to actual vehicle use by drivers and not based on laboratory measurements as the current New European Driving Cycle (NEDC). Additionally, in 2019 a new even more restrictive standard, the Real Driving Emissions (RDE), is expected to come into force in 2019. The new RDE will reflect consumptions more accurately and in real-life conditions. Moreover, it will force the automotive sector and its value chain to develop solutions to avoid losing competitiveness or even being forced out of the market. As a result of this, one of the main strategic lines implemented by car manufacturers consists of reducing the weight of components; and this requires new lighter materials.

Driven by these needs from the transport sector, steel manufacturers have developed new high mechanical strength grades which achieve reduced thickness in carbody parts. Over recent years, this vehicle weight loss has experienced a major breakthrough thanks to the development of new mainly multiphase Advanced High-Strength Steels known as AHSS. Nowadays, these steels, used in chassis and carbody structural components, are characterised by a combination of high mechanical strength values (from 600 to 1500 MPa). However, AHSS steels are less formable than the conventional grades which have been traditionally used in the car industry. This, combined with the formation of unexpected fractures and the evolution of automotive sector geometries which demands highly complex forming operations, are the current challenges faced by the stamping and deep drawing sector, which this project aims to solve.

From the mechanical and fracture prediction point of view, models may be divided into two scales: i) microscopic scale (micro or micro-scale); and ii) macroscopic scale (macro or macro-scale).

Micro-scale or micro mechanics (in micrometres) analyses phenomena from the viewpoint of dislocations, grains, interactions between phases, etc. This scale includes material unevenness and plays a major role in understanding failure and describing damage evolution in materials. Understanding how different the micro components of a material behave at a micro scale, enables us to comprehend and predict (although with complexity) the material behaviour at a macro scale. The current computational techniques facilitate addressing these issues at different scales, using what is known an as **multiscale models.**

Furthermore, the mechanics of continuous media at a macro scale (in the millimetre to meter order), considers the material is homogeneous and uses **phenomenological models** based on tension and deformation statuses to predict material limits. From an engineering viewpoint, macro scale has always been more practical, due to its reduced complexity and shorter computation times, and the different issues during the forming process have usually been addressed from this perspective. Nevertheless, the models available today in FEM software products on the market are not capable of reproducing AHSS failure with accuracy, as they are increasingly complex and require more sophisticated models.

The aim of this PhD scholarship is to develop a multiscale model (see Figure 1) capable of predicting failure in AHSS steels and providing computational efficiency to further industrial applications.

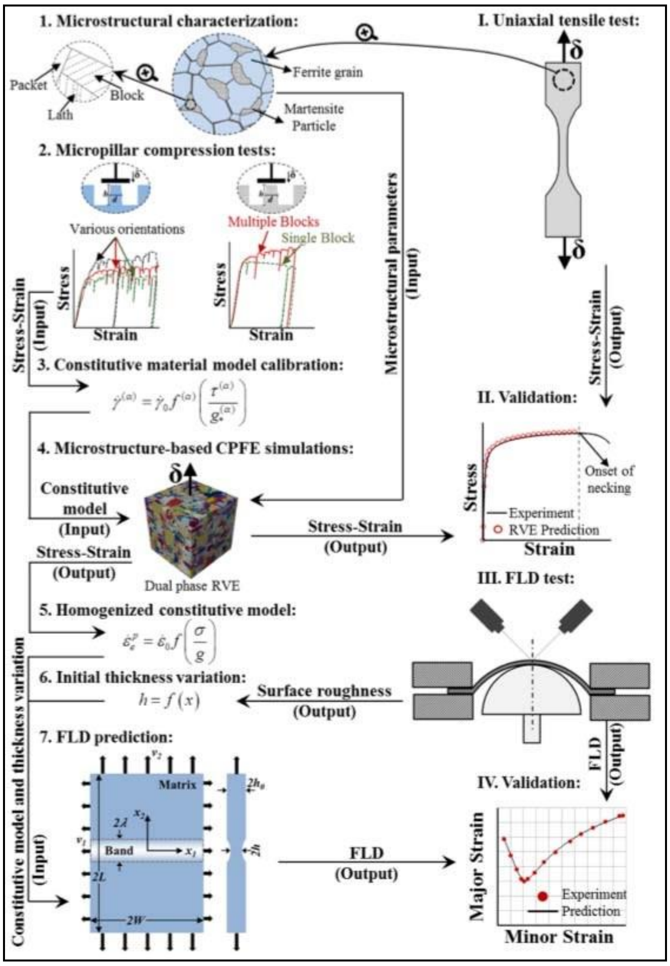

Figure 1. Multi-scale model example.

REQUIREMENTS:

The PhD candidate shall meet the following requirements:

- **Degree and specialisation**: Materials Engineering/Industrial Engineering; mechanical speciality
- **Languages:** Advanced level of English (written and spoken)
- **The following will be a plus**: knowledge of the FEM method; previous experience using Abaqus; and programming in either Fortran or C for witting user subroutines with Abaqus.

More information and applications: http://bit.ly/2IWkvss