Overview of the HARRY\(^2\) project

– **Highly sAfe Robot integRation for the industrY** throughH an **Advanced contRol and monitoRing strategY** –

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 779966 and from the French Région Nouvelle-Aquitaine under grant agreement No 2019-1R5-0116.
Motivations behind the HARRY\(^2\) project

**General objective**
- Provide clear evidences that state-of-the-art control law in Robotics are pertinent in the industry and can run on non-specific, industrially graded, hardware platforms

**Why?**
- Control laws of collaborative robots are very similar to the ones of standard industrial robots
- Safety is dealt with *a posteriori* through a safety controller
- PHRIs are considered as exceptions / situations that should occur rarely
  - Safety is not an intrinsic property of the control law
  - Performances are sub-optimal: the robot stops/switches control modes very often
  - Collaboration is difficult if physical interaction is not part of the “normal” control mode

“HARRY\(^2\) bridges the gap between control and safety in collaborative robotics. Safety should no longer be an exception but a real-time control constraint.”
Auctus team@Inria: Auctus research activities are dedicated to the analysis and modeling of human activities at work as well as to the study of human/robot coupling in order to synthetise collaborative robots physical and control architecture matching real human needs.

RoBioSS team@Pprime: RoBioSS team at Pprime designs and controls complex mechatronic systems for production machines and defines methodologies for evaluating the biomechanical comfort of human operators.

FuzzyLogicRobotics: FLR aims at democratizing the use of industrial robots by proposing and user-friendly human-robot interfaces, which take the complexity and hassle out of working with robots. To do so, we put the latest and greatest robotic research into our systems to make working with industrial robots, safe, intuitive and efficient.
Control approach?

Difficulties
- Reactivity, Performance, Safety?

Industrial practice / “Classical” control approaches
- Planning
- Geometric approach to safety
- Safety exceptions to deal with constraints

State of the art approach
- Closing the perception loop with continuous information
- Formulate control laws as optimization problems with constraints
- Consider dynamics and energy

Validate
- Measure dissipated energy in case of contact
**HARRY² realistic trials**

**Applicative scenario**: Aeronautic drilling in a shared workspace context

**Milestones**

- **M1** Velocity level QP controller integrating energetic constraints on a Comau Racer3
- **M1** Controller running on an industrial grade real-time PC (B&R)
- **M1** Continuous modulation of the allowed level of energy using a laser scanner
- **M1** Validation of the dissipated energy using a GTE sensor
- **M2** High-level and intuitive tasks and constraints description interface
- **M2** Procedure for systematic validation of the dissipated energy using a GTE sensor