Overview of the **IBEX** library

**Jordan NININ**  
ENSTA-Bretagne, Lab-STICC, IHSEV team, 2 rue Francois Verny, 29806 Brest, France

**Gilles CHABERT**  
Ecole des Mines de Nantes, LINA, TASC team, 4 rue Alfred Kastler, 44300 Nantes, France

**Mots-clefs :** Contractor Programming, Interval Analysis, Global Optimization

**IBEX** is an open-source C++ library for constraint processing over real numbers [1]. It provides reliable algorithms for handling non-linear constraints. In particular, roundoff errors are also taken into account. It is based on interval arithmetic and affine arithmetic. The main feature of **IBEX** is its ability to build strategies using contractor programming. The concept of **contractor** is directly inspired by the concept of filtering algorithms in constraint programming [2]. The strength of **IBEX** lies mainly in this concept. Every algorithm in **IBEX** is included as a **Contractor** [1].

Two emblematic problems can be addressed with **IBEX**:

(i) **Systems solving**: A guaranteed enclosure for each solution of a system of (nonlinear) equations is calculated;

(ii) **Global optimization**: A global minimizer of a function under non-linear constraints is calculated with guaranteed and reliable bounds on the objective minimum.

Due to the modularity of this framework, several projects are based on **IBEX** to solve more specific problems:

1. **DynIbex** offers a set of validated numerical integration methods based on Runge-Kutta schemes to solve initial value problems of ordinary differential equations and for DAE in Hessenberg index 1 form [3].

2. **ViabIbex** is a software designed to approximate viability kernel of 2D problems [4].

3. **BubbIbex** proves that a controlled non-linear system always stays inside a time moving bubble [5].

4. **SynthIbex** synthesizes $H_{\infty}$ Robust Control Law under structured constraints [6].

**Références**

[1] **IBEX**: a C++ numerical library based on interval arithmetic and constraint programming.  


