Z-opt

General purpose optimization

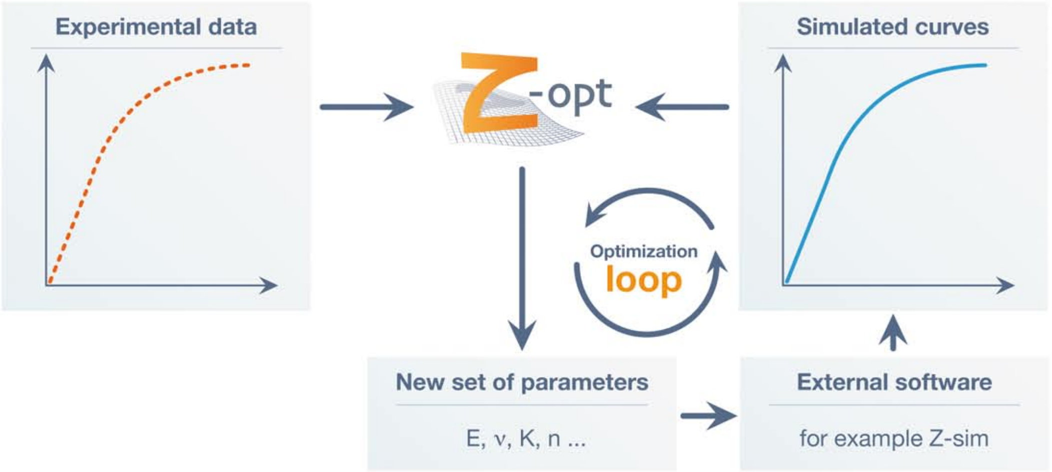
- General optimization package
- Easy interfacing
- Modular management of optimization process

Z-opt is a general purpose optimization package that can be interfaced with any external software accepting ASCII input files. **The package is designed as a tool for material parameters identification**, where the optimal parameters are defined as minimizing the difference between a set of experimental data and simulated curves

Z-opt is the perfect partner of Z-mat (behavior definition) and Z-sim (material integration) for material parameters identification

The experimental data can be any number of tests (tensile test, creep test, etc.) from the user's experimental data base. **Z-opt** can also drive external software to compute the simulated data, and can thus optimize any kind of parametrized problem. For example, it can be used to optimize friction coefficients, convection parameters in thermal computations, shape optimization, etc. in finite element models.

Z-opt operates as following: given an initial set of parameters, **Z-opt** computes the least-square distance between experiments (stored in data files) and simulation results (obtained with **Z-sim**, or any other computation software). The algorithm then estimates a better set of parameters using the algorithm selected by the user. This set of parameters replaces the previous one, and the computation is run again. The optimization loop ends when the optimal set of parameters is reached.



External software is not required if the simulated curve can be defined by an analytical function: in that case, **Z-opt** computes this function and performs the optimization internally. Several optimization methods are available in the package, accounting for its versatility on a wide range of optimization problems:

- Two gradient-driven methods: **Levenberg-Marquardt** particularly efficient for least-square type of cost-functions, and **SQP,** a more general state-of-the-art algorithm for constrained optimization;
- **Simplex**, a heuristic local method which doesn't need the gradient analysis and is very efficient on strongly non-linear problems;
- **Genetic algorithm**, that can bypass local minima in the case of non-convex optimization problems and is insensitive to the search starting point.

Z-opt General purpose optimization
Z-set is distributed by
TRANSVALOR (France)
and NW Numerics & Modeling, Inc (USA)
www.zset-software.com

Example of optimization input file

```
****optimize levenberg_marquardt
 ***shell foo.exe + options...
 ***files foo.input
 ***values
    yield1  200.  min  0.  max 1000.
    yield2  250.  min  0.  max 1000.
    yield3  300.  min  0.  max 1000.
    yield4  350.  min  0.  max 1000.
 ***convergence
    perturb 0.005
    iter 200
 ***compare
    t file file foo.output 1 2 ref.dat 1 3
****return
```

- Optimization method
- Shell command to run the external software
- File(s) containing optimization parameters
- Parameter name, initial values, min and max values
- Convergence parameters of the method
- Comparisons type between reference data and results from foo.exe

Application software template input file

```
*HEADING
Typical Abaqus input file
*NODE,NSET=ALL
...
*ELEMENT,TYPE=C3D8,ELSET=SOLID
...
*MATERIAL,NAME=PLASTIC
*PLASTIC,HARDENING=ISOTROPIC
?yield1 ,0.
?yield2 ,0.0001
?yield3 ,0.001
?yield4 ,0.01
...
```

- Simply replace numerical values by parameter names prefixed by ”?” and Z-opt will automatically generate external input files with trial values of the optimization parameters.