

Optimize3: An optimization package for *morpho*

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Chapter 1

Overview

The `optimize3` module provides a number of classes that aim to facilitate solution of the shape optimization problems for which *morpho* was designed (Fig. 1). There are three main kinds of class defined by the module:

OptimizationProblem objects are used to describe the problem to be solved. Functionals may be added to the problem either as energies or constraints with set target values.

OptimizationAdapter objects take an *OptimizationProblem* and a target object, such as a Mesh or a Field, and provide an interface to compute the value of the objective function and gradients with respect to the target object. OptimizationAdapters also enable setting and getting parameters as well as calculating the value of the objective function, constraints and gradients, all through a common interface.

OptimizationController objects implement an optimization algorithm. Controllers call appropriate methods on an OptimizationAdapter to obtain value and gradient information, and update the parameters as the algorithm proceeds.



Figure 1.0.1: **Classes in the optimize module** and how they interact.

1.1 OptimizationProblem

1.2 OptimizationAdapter

Subclasses of OptimizationAdapter exist to assist optimization of different kinds of object, e.g. MeshAdapter and FieldAdapter. These are typically created like so:

```
var madapt = MeshAdapter(problem, mesh)
var fadapt = FieldAdapter(problem, field)
```

Once created, OptimizationAdapters implement the following methods:

1.2 set(x)

Sets the current value of the parameters to x , which should be supplied as a column vector.

1.2 get()

Returns the current value of the parameters as a column vector.

1.2 value()

Returns the value of the objective function.

1.2 gradient()

Returns the gradient of the objective function at the current parameters as a column vector.

1.2 constraintvalue()

Returns a List containing the value(s) of any constraints.

1.2 constraintgradient()

Returns a List containing the gradient(s) of any constraints as column vectors.