oops!: Open Object-Oriented Parallel Solutions: A C++ Class Library for the Solution of Transport Equations

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At LIAG, geothermal energy utilization is the main area were we use numerical models to develop and enhance process understanding and to predict the dynamics of the system under consideration. Other topics include spontaneous underground coal fires and subrosion processes. Although the details make it inconvenient if not impossible to apply a single code implementation to all systems, their investigations go along similar paths: They all depend on the solution of coupled transport equations.

We thus saw a need for a modular code system with open access for the various communities to maximize the shared synergistic effects. To this purpose we develop the *oops!* (**o**pen **o**bject-oriented **p**arallel **s**olutions) - toolkit, a C++ class library for the numerical solution of mathematical models of coupled thermal, hydraulic and chemical processes. This is used to develop problem-specific libraries like *acme*(**a**mendable **c**oal-fire **m**odeling **e**xercise), a class library for the numerical simulation of coal-fires and applications like *kobra* (**Ko**hle**bra**nd, german for coal-fire), a numerical simulation code for standard coal-fire models. The latest development just started is the *SIMBA* toolkit for the simulation of geothermal plants.

Basic principle of the code system is the provision of data types for the description of space and time dependent data fields, description of terms of partial differential equations (pde), their discretisation and solving methods. Coupling of different processes, described by their particular pde is modeled by an automatic timescale-ordered operator-splitting technique. If in a derived specific application library functionalities of general interest are implemented and have been tested they will be assimilated into the main library. Interfaces to external pre- and post-processing tools are easily implemented. Thus a construction kit which can be arbitrarily amended is formed.