

On the implementation of the functional-structural tree model LIGNUM

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The simulation program implementing the model LIGNUM

The functional-structural tree model LIGNUM represents the tree crown for coniferous and deciduous trees with four structural units. The units are tree segment, branching point, bud and axis. LIGNUM is intended as a generic modeling tool for woody perennial plants (Perttunen et. al., 1996, Perttunen et. al., 2001) and shrubs (Salemaa et. al., 2003). The growth of different species is simulated by changing model parameters, descriptions of metabolism and structural dynamics (birth, growth and senescence of the structural units) and the tree architecture is represented with Lindenmayer systems (Perttunen and Sievänen, 2005). Photosynthetic production depends on the photosynthetically active solar radiation in the tree crown.

The model LIGNUM is being developed with C++ language and STL library using generic programming. We do not emphasize polymorphism or inheritance (i.e. object oriented paradigm) in program design but instead implement the structural units of the model as abstract classes using C++ template mechanism. The template mechanism allows specifications how one data type is generated given another type as an argument. This modelling paradigm implements a tree as an abstract data type. It has the important advantage that we can implement generic algorithms to work for this common framework of a tree reducing the work to implement different tree species.

We will present the general program architecture and the new features such as the graphical user interface and the use of XML allowing the persistence of simulated trees, i.e. they can be saved into a file for later analysis. These features are implemented with Qt 4 library (see www.trolltech.com) that enables the use of LIGNUM in leading operating systems including Windows, Linux and Mac OS X. We will also present some modelling work done with LIGNUM.

References

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