SEPCI: A R package to compute Spatially Explicit Competition Indexes

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Introduction

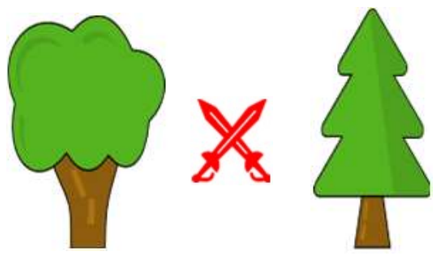
Competition is driving plant growth by modulating jointly with other drivers the potential growth due to site, genetic and ontogeny factors. Usually, competition is assessed in plant growth modelling and analysis by non-spatially explicit indices. However, stand spatial structure defined by plants positions and relative sizes is crucial in terms of stand growth allocation between trees. Several software tools exist for computing spatially explicit competition indices, with *siplab* being a notable R package. However, using *siplab* requires additional coding to define specific indices. In response, we present *sepci*, an R package that builds upon *siplab* and includes methods for computing both known spatially explicit competition indices and novel indices that depend on measures retrievable with profile functions.

Approach

(a) Data Input

The stand data must contain tree geographic position (e.g x and y position values) and must be provided as a marked point pattern (an object of class *ppp* in R).

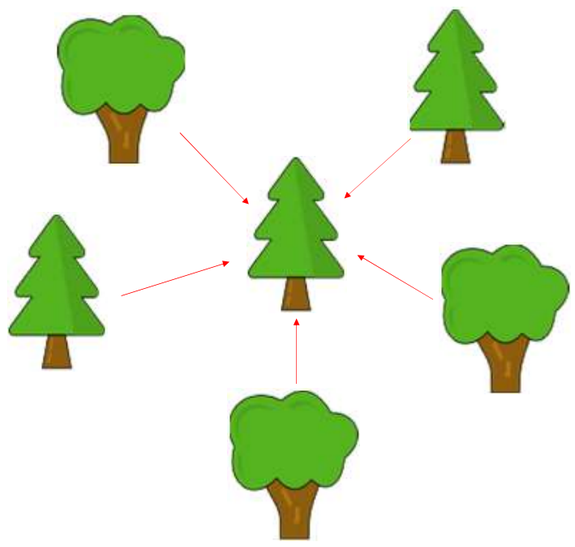
(b) Competitors



***Siplab* (the package that *sepci* extends) provides different ways to select which trees are competitors of a given tree:**

- **Trees inside a circle of fixed radius**
- **The nearest n trees**
- **Trees whose area of influence (depending on a tree trait) intersect with the area of influence of given tree**
- **Angle counting method**
- **Trees intersected by a vertical cone influence zone**

(c) Competition Indexes



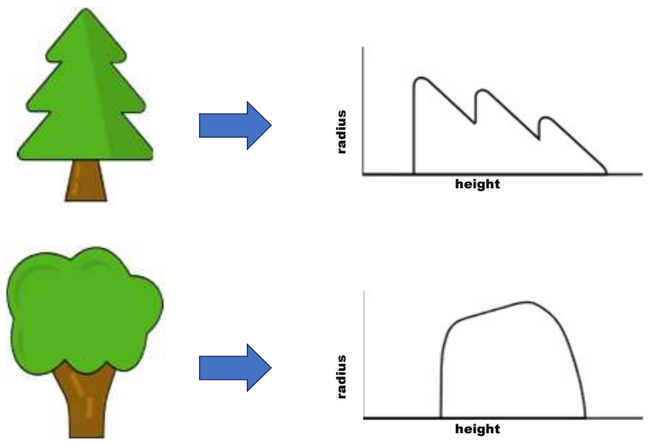
Competition indexes are computed using *siplab pairwise* function. This function computes the competition effects of each pair trees and sums the for a each tree to get the competition index:

$$index = \sum_{i=1}^{n\_competitors} Competition\_effect_i$$

How the competition effect is computed depends on the user. Between *siplab* and *sepci* multiple options are provided:

- **Hegyi index**
- **Alemdag index**
- **Martin & Ek index**
- **Bella index**
- **Point density index**
- **Indexes that uses crown metrics at variable heights**

(d) Crown metrics equations



Some indexes use traits based on locally parametrized profile equations (e.g crown projection area at a given height). Profile equations can be programed manually (e.g using literature equations) or using geometric approaches supported by *sepci* (cone or two half ellipsoid profiles). This profile equations can be numerically integrated using *sepci* to get different functions:

- **Crown projection area at a given height**
- **Crown volume above a given height**
- **Crown surface above a given height**

At the end we should have for each tree a function that given a height returns the trait (radius of the crown, crown projection area, …) of the tree at that height

References

Garcia O (2014). "Siplab, a spatial individual-based plant modelling system." *Computational Ecology and Software*, 4(4), 215–222

Acknowledgments

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