Vegetation community patterns, Reference sheet, JUST LAYOUT!!! October 11, 2024

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In [FPBUM24] we give a bifurcation analysis of the vegetation community–water model

$$\partial_t B_i = ... \tag{1}$$ m1

where ... For further details and in particular parametr values we refer to [FPBUM24].

The main focus is on the interplay of spatial pattern formation and community reassembly under drying trends, i.e., under a decrease of P, in the `Matlab` folder `bwhcom`. However, as a preparatory step we also study the single species models with $\chi = 0$ and $\chi = 1$, respectively, in the folder `bwhsingle`, which we describe first.

The single species models (SSM) are standard semilinear RD systems and hence can be treated similar to the models in [Uec21, Ch.9], and associated demos available at [Uec24]. We also refer to [Uec21] and the tutorials at [Uec24] for general background and usage of `pde2path`. However, the SSM folder also come with a few tricks such as the computation of Busse Ballons (BBS) via branch point continuation (BPC). Table 1 lists the pertinent files. tab1

Table 1: Scripts and functions in `bwhsingle`. Associated to most `cmds*`–scripts are `cmds*plot` scripts for plotting; all figure numbers refer to [FPBUM24]. 1st two blocks: scripts; 3rd block: problem describing functions and overloads of `pde2path` library functions and convenience functions. tab1

file	purpose, remarks
`cmds1`	starting script ... Fig.4
`bwhinit`	initialization of problem struct `p` with standard parameter values, call of `stanpdeo1D` to generate a 1D PDE object (interval, with mesh), initialization of u with u^*, call of `oosetfemops` to generate the FEM matrices, and finally resetting of some `pde2path` parameters to problem adapted values.
`oosetfemops`	assemble and store the mass matrix M, and the (1-component) Neumann-Laplacian K.
`sG,sGjac`	rhs of (??), and Jacobian; these here have a simple standard structure. sch2
`nodalf`	"nonlinearity", i.e., terms without spatial derivatives, called in `hotintxs`.
`nodaljac`	Jacobian of "nonlinearity", called in `sGjac`.
`bpjac`	implements $\partial_u(G_u\phi)$ for BPC, see [Uec21, §3.6.1].
`sgbra`	mod of library function `stanbra`;
`secobraHPC`	mod of `secobra` used for output during HPC.

The community model (1) is different from the "standard" RD system demos of `pde2path`, and hence requires some special setup. See Tab.2...

Table 2: Scripts and functions in `bwhcom`. Associated to most `cmds*`–scripts are `cmds*plot` scripts for plotting; all figure numbers refer to [FPBUM24]. 1st two blocks: scripts; 3rd block: problem describing functions; 4th block: overloads of `pde2path` library functions and convenience functions. tab2

file	purpose, remarks
`cmds1`	
`bwhinit`	initialization
`sgbra`	...
`userplot`	...
`bbdns`	...

References

FPBUM24

[FPB+24] M. A. Ferré, I. Pavithran, B. Bera, H. Uecker, and E. Meron. Vegetation pattern formation and community assembly under drying climate trends, 2024.

p2pbook

[Uec21] H. Uecker. *Numerical continuation and bifurcation in Nonlinear PDEs*. SIAM, Philadelphia, PA, 2021.

p2phome

[Uec24] H. Uecker. `www.staff.uni-oldenburg.de/hannes.uecker/pde2path`, 2024.