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%*********************  MATLAB TDR SYSTEM  ***********************************
%* File          : tdrExamples/DiffReac/DiffReac.tex
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%*
%* The TDR system in Matlab has been implemented by
%*   Mathias Franz (Oct 2004 - Feb 2005)
%*   Alf Gerisch   (Oct 2004 -         )
%*****************************************************************************
```

This example implements the scalar linear diffusion-reaction equation

$$\partial_t u = \nabla \cdot (D \nabla u) + g(u)$$

with constant positive diffusion coefficient $D > 0$ and reaction function $g(u)$. We always use a value $D = 1$. The reaction function can be either $g \equiv 0$, or of logistic type $g(u) = \alpha u^\beta(1-u)$ with $\alpha, \beta > 0$, or of a generalised logistic type $g(u) = -\alpha u(1-u)(\beta - u)$. In the generalised logistic case, $\alpha > 0$ and $-1 \leq \beta < 1$; the case with $0 < \beta < 1$ is what the geneticists refer to as the heterozygote inferiority case; we refer to [T. Kawahara and M. Tanaka. *Interactions of traveling fronts: An exact solution of a nonlinear diffusion equation.* Physics Letters A, 97:311-314, 1983] and the references cited there for details.
The spatial domain is either the 2D domain $(x, y) \in \Omega := (0, 1) \times (y_0, y_0 + 1)$ with parameter $y_0 \geq 0$ or the 3D axi-symmetric domain with cross section Ω and the x-axes as axis of symmetry, that is $(x, r(y, z)) \in \Omega$. The model is used to compare these two cases. The equation is considered for $t \geq t_0 = 0$.
The initial condition is always independent of x and in the 2D case can be either (`selectICandBC = 1`)

$$u(0, x, y) = (y - y_0)^2 \exp(-50(y - y_0 - 1)^2)$$

corresponding to a peak along $y = 1 + y_0$ and rapidly decaying towards zero for $y \to y_0$, or (`selectICandBC = 2`)

$$u(0, x, y) = \exp(-50(y - y_0 - 0.3)^2)$$

corresponding to a peak along $y = 0.3 + y_0$ and rapidly decaying towards zero for $y \to y_0$ and $y \to 1 + y_0$. In the axi-symmetric case, y is simply replaced by $r(y, z)$.
In the case `selectICandBC = 1` we use constant Dirichlet boundary conditions (equal to one) along the boundary $y = y_0 + 1$ in case of a 2D spatial domain (and along the boundary $r(y, z) = y_0 + 1$ in case of the axi-symmetric spatial domain). On the remaining boundary parts we use zero-flux conditions. In the case `selectICandBC = 2` we use zeros flux condition on all the boundary.
The problem and its solution are independent of the x-coordinate. Therefor we use in that direction a coarse grid only.