Preparing a Poster for ŠVK is Really Easy

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Introduction

Here we show how easy it is to prepare a poster for ŠVK. There are some differences in preparing a poster compared to preparing a paper:

- use *less text*, since people are not going to stand in front of your poster forever and read all your text,
- use *more figures*, because they quickly draw the eye of the reader to the most important points on your poster,
- use *simple structure* (no numbered theorems, subsections, or numbered figures)
- cite onle *the most important references*

Sample text

Let $S = [s_{ij}]$ $(1 \le i, j \le n)$ be a $(0, 1, -1)$-matrix of order n. Then S is a *sign-nonsingular matrix* (SNS-matrix) provided that each real matrix with the same sign pattern as S is nonsingular. In this paper we consider the evaluation of integrals of the following forms:

$$\int_a^b \left(\sum_i E_i B_{i,k,x}(t) \right) \left(\sum_j F_j B_{j,l,y}(t) \right) dt, \tag{1}$$

$$\int_a^b f(t) \left(\sum_i E_i B_{i,k,x}(t) \right) dt, \tag{2}$$

where $B_{i,k,x}$ is the ith B-spline of order k defined over the knots $x_i, x_{i+1}, \ldots, x_{i+k}$.

1. Use Gauss quadrature on each interval.
2. Convert the integral to a linear combination of integrals of products of B-splines and provide a recurrence for integrating the product of a pair of B-splines.
3. Convert the sums of B-splines to piecewise Bézier format and integrate segment by segment using the properties of the Bernstein polynomials.
4. Express the product of a pair of B-splines as a linear combination of B-splines. Use this to reformulate the integrand as a linear combination of B-splines, and integrate term by term.
5. Integrate by parts.

Of these five, only methods 1 and 5 are suitable for our purposes.

Some displayed equations

By introducing the product topology on $R^{m\times m} \times R^{n\times n}$ with the induced inner product

$$\langle (A_1, B_1), (A_2, B_2) \rangle := \langle A_1, A_2 \rangle + \langle B_1, B_2 \rangle, \tag{3}$$

we calculate the Fréchet derivative of F as follows:

$$\begin{aligned} F'(U,V)(H,K) &= \langle R(U,V), H\Sigma V^T + U\Sigma K^T \\ &\quad - P(H\Sigma V^T + U\Sigma K^T) \rangle \\ &= \langle R(U,V), H\Sigma V^T + U\Sigma K^T \rangle \\ &= \langle R(U,V) V \Sigma^T, H \rangle + \\ &\quad \langle \Sigma^T U^T R(U,V), K^T \rangle. \end{aligned} \tag{4}$$

In the middle line of (4) we have used the fact that the range of R is always perpendicular to the range of P. The gradient ∇F of F, therefore, may be interpreted as the pair of matrices:

$$\begin{aligned} \nabla F(U,V) &= (R(U,V) V \Sigma^T, R(U,V)^T U \Sigma) \\ &\in R^{m\times m} \times R^{n\times n}. \end{aligned} \tag{5}$$

Thus, the vector field

$$\frac{d(U,V)}{dt} = -g(U,V) \tag{6}$$

defines a steepest descent flow on the manifold $\mathcal{O}(m) \times \mathcal{O}(n)$ for the objective function $F(U,V)$.

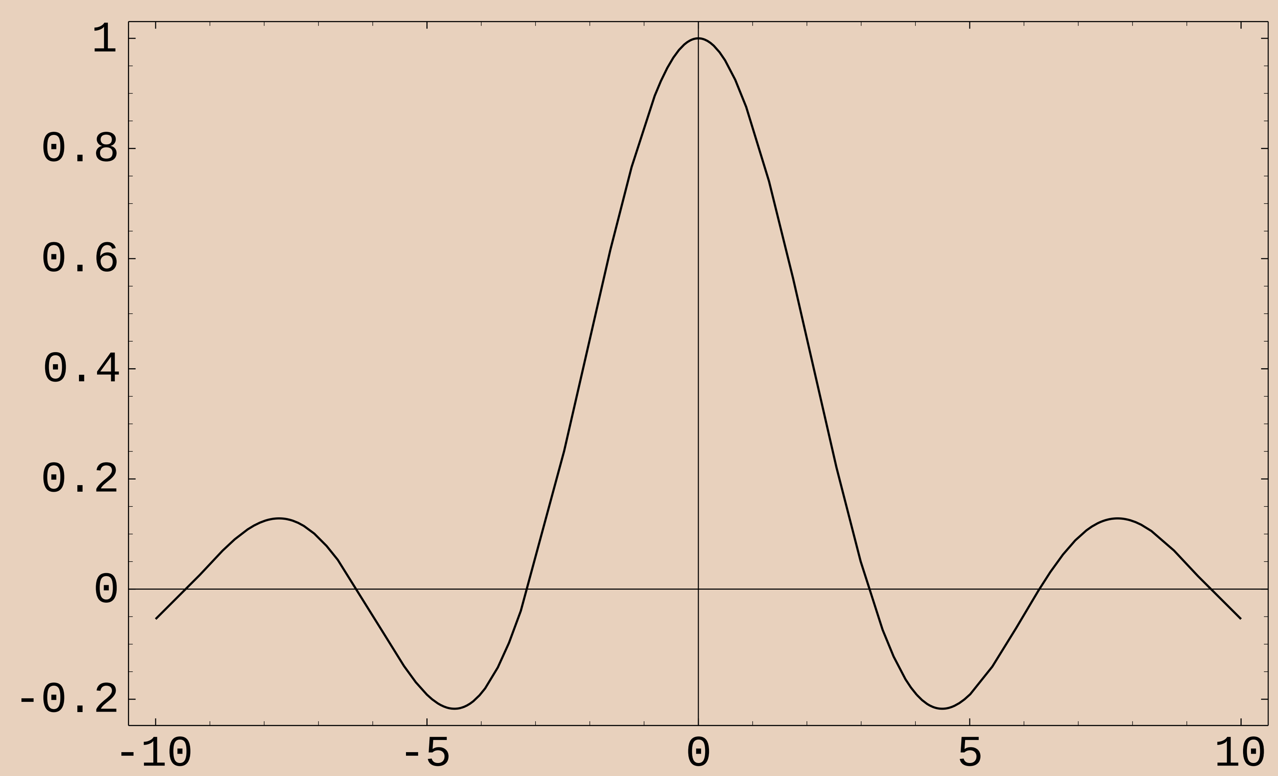
Numerical experiments

We conducted numerical experiments in computing inexact Newton steps for discretizations of a *modified Bratu problem*, given by

$$\begin{aligned} \Delta w + c e^w + d \frac{\partial w}{\partial x} &= f \quad \text{in } D, \\ w &= 0 \quad \text{on } \partial D, \end{aligned} \tag{7}$$

where c and d are constants. The actual Bratu problem has $d = 0$ and $f \equiv 0$. It provides a simplified model of nonlinear diffusion phenomena, e.g., in combustion and semiconductors, and has been considered by Glowinski, Keller, and Rheinhardt [Glowinski et al., 1985], as well as by a number of other investigators; see [Glowinski et al., 1985] and the references therein. See also problem 3 by Glowinski and Keller and problem 7 by Mittelmann in the collection of nonlinear model problems assembled by Moré [Moré, 1990]. The modified problem (7) has been used as a test problem for inexact Newton methods by Brown and Saad [Brown and Saad, 1990].

In our experiments, we took $D = [0,1] \times [0,1]$, $f \equiv 0$, $c = d = 10$, and discretized (7) using the usual second-order centered differences over a 100×100 mesh of equally spaced points in D. In GMRES(m), we took $m = 10$ and used fast Poisson right preconditioning as before.



Graph of the function $\sin(x)/x$.

References

[Brown and Saad, 1990] Brown, P. N. and Saad, Y. (1990). Hybrid Krylov methods for nonlinear systems of equations. *SIAM J. Sci. Statist. Comput.*, 11:450–481.

[Glowinski et al., 1985] Glowinski, R., Keller, H. B., and Rheinhart, L. (1985). Continuation-conjugate gradient methods for the least-squares solution of nonlinear boundary value problems. *SIAM J. Sci. Statist. Comput.*, 6:793–832.

[Moré, 1990] Moré, J. J. (1990). A collection of nonlinear model problems. In Allgower, E. L. and Georg, K., editors, *Computational Solutions of Nonlinear Systems of Equations*, volume 26 of *Lectures in Applied Mathematics*, pages 723–762, Providence, RI. American Mathematical Society.