**Algorithm S2** Sparse Backfitting

**for** $i = 1 : d$ **do**
  **input** Concatenated derivative estimates: $\hat{\dot{\boldsymbol{x}}}_i = (\hat{\dot{x}}_i^1(t_1), ..., \hat{\dot{x}}_i^R(t_n))'$.
  **input** Concatenated trajectory estimates: $\hat{\boldsymbol{x}}_j = (\hat{x}_j^1(t_1), ..., \hat{x}_j^R(t_n))'$,
    $j = 1, ..., d$.
  **input** Smoothing parameter $\lambda_{1i}$ and sparsity parameter $\lambda_{2i}$.
  **initialize** $\boldsymbol{f}_{ij} \leftarrow 0 \in \mathbb{R}^N$, for $j = 1, ..., d$, where $N = nR$.
  **compute** $\hat{\alpha}_i \leftarrow N^{-1} \sum_{k=1}^{N} \hat{\dot{\boldsymbol{x}}}_{ik}$.
  **repeat**
    *Store starting values* $\boldsymbol{f}_i^{\star} \leftarrow \boldsymbol{f}_i$.
    **for** $j = 1 : d$ **do**
      *Compute residuals* $\boldsymbol{r} \leftarrow \hat{\dot{x}}_i - \hat{\alpha}_i - \sum_{\ell \neq j} \boldsymbol{f}_{i\ell}(\hat{\boldsymbol{x}}_\ell)$
      *Smooth* $\boldsymbol{f}_{ij} \leftarrow S_j(\lambda_{1i})\boldsymbol{r}$
      *Estimate Norm* $s^2 \leftarrow \left(N^{-1} \sum_{k=1}^{N} \boldsymbol{f}_{ijk}^2\right)^{\frac{1}{2}}$
      *Soft Threshold* $\boldsymbol{f}_{ij} \leftarrow (1 - \lambda_{2i}/s^2)_+ \boldsymbol{f}_{ij}$
      *Center* $\boldsymbol{f}_{ij} \leftarrow \boldsymbol{f}_{ij} - \bar{\boldsymbol{f}}_{ij}$
    **end for**
  **until** *Convergence* $\sup_{j=1,...,d} \sup_{k=1,...,N} |\boldsymbol{f}_{ijk} - \boldsymbol{f}_{ijk}^{\star}| < \epsilon$.
**end for**