Supporting Information

Optimization of STEM-HAADF electron tomography reconstructions by parameter selection in compressed-sensing Total Variation Minimization-based algorithms

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Figure S1. Influence of the many different parameter combinations on the recovery of the noised "Shepp-Logan" phantom. Reconstructions were made from -70° to $+70^\circ$ every 2° ($-70:2:70$).

Figure S2. Influence of (μ, β) parameter combination on the recovery of the noised "porous square" phantom using TVM2D ($-70^\circ:2^\circ:70^\circ$).

Figure S3.- Orthoslices through a volume reconstructed by (μ, β) parameter selection using TVM (right) and TVM3D (left).

		β											
μ		2^1	2^2	2^3	2^4	2^5	2^6	2^7	2^8	2^9	2^{10}	2^{11}	2^{12}
	2^1	0.6352	0.6861	0.7283	0.7620	0.7939	0.8312	0.8634	0.8997	0.9329	0.9938	1	0.9993
	2^2	0.5740	0.6227	0.6694	0.7079	0.7456	0.7773	0.8136	0.8475	0.8687	0.8896	0.9999	0.9993
	2^3	0.5174	0.5635	0.6028	0.6417	0.6762	0.7171	0.7484	0.7806	0.8139	0.8370	0.9321	0.9992
	2^4	0.4681	0.5033	0.5317	0.5559	0.5835	0.6103	0.6627	0.7013	0.7361	0.7642	0.8303	0.9812
	2^5	0.4288	0.4477	0.4651	0.4778	0.4836	0.5095	0.5531	0.5989	0.6437	0.6878	0.7917	0.8319
	2^6	0.4017	0.4129	0.4212	0.4279	0.4331	0.4414	0.4638	0.4901	0.5353	0.5656	0.6692	0.8320
	2^7	0.3842	0.3918	0.3971	0.4002	0.4032	0.4043	0.4130	0.4283	0.4451	0.4695	0.5590	0.7210
	2^8	0.3725	0.3772	0.3803	0.3810	0.3831	0.3858	0.3877	0.3913	0.4011	0.4137	0.4493	0.5797
	2^9	0.3662	0.3679	0.3681	0.3686	0.3683	0.3700	0.3739	0.3767	0.3785	0.3844	0.3985	0.4661
	2^{10}	0.3615	0.3620	0.3614	0.3615	0.3613	0.3613	0.3622	0.3654	0.3698	0.3731	0.3787	0.4089
	2^{11}	0.3590	0.3585	0.3585	0.3575	0.3579	0.3586	0.3579	0.3578	0.3608	0.3638	0.3676	0.3772
	2^{12}	0.3567	0.3575	0.3580	0.3557	0.3563	0.3565	0.3563	0.3561	0.3564	0.3572	0.3627	0.3713
	2^{13}	0.3561	0.3564	0.3581	0.3547	0.3553	0.3553	0.3556	0.3551	0.3568	0.3557	0.3561	0.3555
	2^{14}	0.3555	0.3552	0.3557	0.3555	0.3554	0.3553	0.3555	0.3550	0.3554	0.3552	0.3553	0.3554
	2^{15}	0.3550	0.3556	0.3549	0.3547	0.3555	0.3550	0.3548	0.3553	0.3550	0.3547	0.3551	0.3558
	2^{16}	0.3548	0.3550	0.3553	0.3550	0.3557	0.3555	0.3553	0.3551	0.3551	0.3557	0.3546	0.3549
	2^{17}	0.3554	0.3544	0.3543	0.3548	0.3551	0.3549	0.3544	0.3553	0.3551	0.3550	0.3546	0.3552
	2^{18}	0.3549	0.3550	0.3549	0.3552	0.3562	0.3554	0.3543	0.3546	0.3555	0.3544	0.3550	0.3547
	2^{19}	0.3557	0.3548	0.3551	0.3550	0.3551	0.3545	0.3547	0.3546	0.3551	0.3551	0.3555	0.3545
	2^{20}	0.3547	0.3552	0.3552	0.3548	0.3548	0.3549	0.3550	0.3547	0.3547	0.3552	0.3547	0.3564

Table S1. Example of the cumulative error matrix. Each entry corresponds to the addition of the $s - 1$ lowest estimated errors, according to Equation 5, for each (μ, β) pair. The minimum value observed in this case, 0.3543, corresponds to the $\mu = 2^{18}$ and $\beta = 2^7$ combination.

Figure S4.- TVM2D reconstructions ($-70^\circ:2^\circ:70^\circ$) and normalized errors (ρ) of the Shepp-Logan phantom for different (μ, β) combinations.

Figure S5.- Flow chart depicting the different steps involved in the proposed parameter-selection methodology.

Figure S6.- Normalized error (ρ) in the TVM2D reconstruction of the Shepp-Logan phantom for different (μ, β) combinations. ρ vs $\log_2(\mu)$ and $\log_2(\beta)$ plot. The minimum ρ value ($2.4 \cdot 10^{-3}$) has been marked with a red point.

Figure S7.- The importance of denoising the original sinogram before reconstructing: (upper row) ordered nanoporous material 2D-phantom; (middle row) noisy and UWT-denoised sinogram of the 2D-phantom; (bottom row) segmentations and pore size (in px^2) histograms of the images reconstructed from the denoised and noisy sinograms, using in both cases the parameter selection approach.

Figure S8.- Pictorial illustration of the influence of β and μ combinations on the recovery of the carbon template structure by TVM3D.

Figure S9.- Workflow to binarize the pore structure. a) orthoslice extracted from parameter selection reconstruction. b) automatic binarization of carbon matrix. c) filled carbon matrix. d) binarization of the pore structure after subtracting (b) and (c).

Figure S10.- (a) 3D rendered volume segmented of pores; (b) 3D rendered volumes reconstructed by CS-TVM3D; (c) segmentation of the orthoslices using conventional approach; (d) 3D rendered volumes reconstructed by CS-TVM3D; (e) 3D rendered volumes reconstructed using the automated parameter selection method; (f) pore size distribution for each orthoslice using the automated parameter selection method.

Figure S11.- Pore size distributions for the mesoporous carbon sample obtained from (a) the segmented/reconstructed volume using the automated parameter selection method and (b) from Nitrogen physisorption isotherm analysis.

Figure S12.- (a) 3D rendered volume of the mesoporous carbon sample after CS-TVM3D reconstruction. The segmentation of the orthoslices corresponding to cuts along the direction of the pores using the conventional reconstruction approach (b) and the automated parameter selection method (c) are shown. Note how in the former the pores are nearly completely lost but evident in the latter.