WxBS: Wide Baseline Stereo Generalizations

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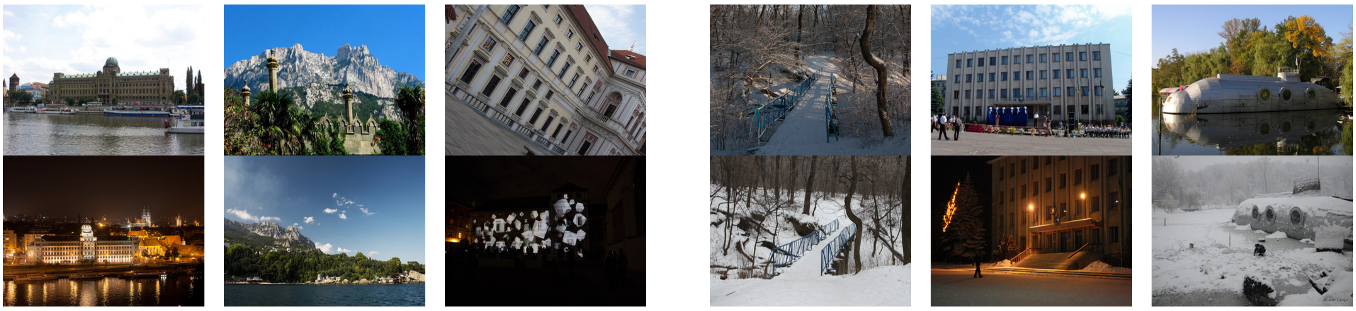
a) WGABS (5 pairs) b) WGSBS (5 pairs) c) WLABS (4 pairs)



d) WGLBS (9 pairs) e) WGALBS (8 pairs)

Figure 1: Examples of image pairs from the WxBS dataset

We consider the generalization of Wide (geometric) Baseline Stereo to WxBS, a two-view image matching problem where two or more of the image formation and acquisition properties significantly change, i.e. they have a *wide baseline*.

The following single wide baseline stereo problems and their combinations are considered: illumination (WLBS) – difference in position, direction, number, intensity and wavelength of light sources; geometry (WGBS) – difference in camera and object pose, scale and resolution - the "classical" WBS; sensor (WSBS) – change in sensor type: visible, IR, MR; noise, image preprocessing algorithms inside the camera, etc; appearance (WABS) – difference in the object appearance because of time or seasonal changes, occlusions, turbulent air, etc.

We present a new public dataset (see Figure 1) with ground truth which combines the above-mentioned challenges and contains both W2BS image pairs including viewpoint and appearance, viewpoint and illumination, viewpoint and sensor, illumination and appearance change and W3BS – problems where viewpoint, appearance and lighting differ significantly.

We propose a novel algorithm for two-view matching in challenging conditions – WxBS-MODS (Algorithm 1). It significantly outperforms the state-of-the-art matchers: ASIFT [2], Dual Bootstrap (DBstrap) [3] and MODS [1] on various WxBS problems without a significant loss of speed (Table 1).

Algorithm 1 MODS-WxBS –
a matcher for wide multiple baseline stereo

Input: I_1, I_2 – two images; θ_m – minimum required number of matches; $S_{\max}$ – maximum number of iterations.
Output: Fundamental or homography matrix F or H;
a list of corresponding local features.

while ($N_{\text{matches}} < \theta_m$) *and* (Iter $< S_{\max}$) **do**
  for I_1 and I_2 separately **do**
    1 Generate synthetic views acc. to the scale-tilt-rotation-detector setup for Iter.
    2 Detect local features using adaptive threshold.
    3 Extract rotation invariant descriptors with:
    3a rSIFT and **3b hrSIFT**
    4 Reproject local features to I_1.
  end for
  5 Generate tent. corresp. based on the first geom.inconsistent rule for rSIFT and hrSIFT separately using kD-tree
  6 Filter duplicates
  7 Geometric verification of *all* TC with modified DEGENSAC estimating F or H.
  8 Check geom. consistency of the LAFs with est. F or H.
end while

[1] Dmytro Mishkin, Michal Perdoch, and Jiri Matas. Mods: Fast and robust method for two-view matching. *CoRR*, abs/1503.02619, 2015.

[2] Jean-Michel Morel and Guoshen Yu. Asift: A new framework for fully affine invariant image comparison. *SIAM Journal on Imaging Sciences*, 2(2):438–469, 2009.

[3] Gehua Yang, Charles V Stewart, Michal Sofka, and Chia-Ling Tsai. Registration of challenging image pairs: Initialization, estimation, and decision. *PAMI 2007*, 29(11):1973–1989, 2007.

Table 1: Comparison of MODS-WxBS, ASIFT and Dual Bootstrap on public datasets.
The number of matched image pairs (left) and the average running time (right).

Alg. / Dataset	EF		EVD		MMS		WGABS		WGALBS		WGLBS		WGSBS		WLABS		Past		OxAff		SymB		GDB	
	# 33	time [s]	# 15	time [s]	# 100	time [s]	# 5	time [s]	# 8	time [s]	# 9	time [s]	# 5	time [s]	# 4	time [s]	# 172	time [s]	# 40	time [s]	# 46	time [s]	# 22	time [s]
State-of-art matchers																								
ASIFT	23	27	5	12	18	3.2	0	52	0	32	0	35	0	12	1	30	62	32	40	102	27	14	15	41
MODS	33	4.8	15	11	27	11	2	41	2	31	1	46	0	17	1	26	94	27	40	3.4	42	18	18	11
DBstrap	31	26	0	18	79	9.3	0	11	0	13	0	13	0	4.7	0	15	16	28	36	24	38	21	16	17
Proposed matcher																								
WXBS-M	33	4.7	15	14	82	12	3	40	3	63	3	61	0	26	3	28	107	42	40	5.1	43	18	22	12