

Track validation using gradient-based normalised cross-correlation – supplementary material

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1 Simplifying normalised cross-correlation

In section 3.1 of the main paper we used a modified version of the normalised cross-correlation (NCC) similarity measure as the basis for our gradient ascent NCC tracker. The similarity $O(\mathbf{u})$ of a template Q and an image patch I displaced from the template by \mathbf{u} is:

$$O(\mathbf{u}) \triangleq \frac{1}{n} \sum_{\mathbf{x} \in R} (I - \bar{I}) (Q - \bar{Q})$$

where n is the number of pixels in the image patch and R is the set of pixel locations in the template. Below, we show that either \bar{I} or \bar{Q} – the means of the image patch and the template, respectively – can be removed from the formula without changing the result.

$$\begin{aligned} O(\mathbf{u}) &= \frac{1}{n} \sum_{\mathbf{x} \in R} (I - \bar{I}) (Q - \bar{Q}) \\ &= \frac{1}{n} \sum_{\mathbf{x} \in R} I (Q - \bar{Q}) - \frac{1}{n} \sum_{\mathbf{x} \in R} \bar{I} (Q - \bar{Q}) \\ &= \frac{1}{n} \sum_{\mathbf{x} \in R} I (Q - \bar{Q}) - \frac{1}{n} \times \bar{I} \sum_{\mathbf{x} \in R} (Q - \bar{Q}) \\ &= \frac{1}{n} \sum_{\mathbf{x} \in R} I (Q - \bar{Q}) - \frac{1}{n} \times \bar{I} \left[\sum_{\mathbf{x} \in R} Q - \sum_{\mathbf{x} \in R} \bar{Q} \right] \\ &= \frac{1}{n} \sum_{\mathbf{x} \in R} I (Q - \bar{Q}) - \frac{1}{n} \times \bar{I} \left[\sum_{\mathbf{x} \in R} Q - \sum_{\mathbf{x} \in R} \left(\frac{1}{n} \sum_{\mathbf{x} \in R} Q \right) \right] \\ &= \frac{1}{n} \sum_{\mathbf{x} \in R} I (Q - \bar{Q}) - \frac{1}{n} \times \bar{I} \left[\sum_{\mathbf{x} \in R} Q - \sum_{\mathbf{x} \in R} Q \right] \\ &= \frac{1}{n} \sum_{\mathbf{x} \in R} I (Q - \bar{Q}) - \frac{1}{n} \times \bar{I} \times 0 \\ &= \frac{1}{n} \sum_{\mathbf{x} \in R} I (Q - \bar{Q}) \end{aligned}$$

2 Datasets

Below, we provide details of the video sequences that make up the dataset used in our experiments.

Dataset	Scenario	Video	Start frame	End frame	Num. frames	Description
CAVIAR	1	WalkByShop1cor	1563	2082	520	Man in grey coat
	2	WalkByShop1cor	1675	2089	415	Woman in brown coat
	3	WalkByShop1cor	618	975	358	Woman in white jumper
	4	WalkByShop1cor	1405	1559	155	Man in white jumper
	5	ShopAssistant1cor	127	259	133	Woman carrying bags
	6	ShopAssistant1cor	400	554	155	Woman in black coat
	7	ShopAssistant2cor	230	606	377	Man in black suit
	8	ShopAssistant2cor	164	603	440	Man in black jacket
	9	ShopAssistant2cor	2800	3328	529	Woman in grey jacket
	10	ShopAssistant2cor	468	792	325	Woman in denim jacket
	11	ThreePastShop2cor	212	552	341	Girl in red jumper
	12	ThreePastShop2cor	157	432	276	Man in dark clothes
	13	ThreePastShop2cor	398	834	437	Man in red jacket
	14	ThreePastShop2cor	1166	1520	355	Woman in white top and black trousers
PETS 2007	15	S03-COUPLE_SWAP_BAG_1/2	2303	2559	257	Man in black jacket and blue jeans
	16	S03-COUPLE_SWAP_BAG_1/2	916	1013	98	Girl with a backpack
	17	S03-COUPLE_SWAP_BAG_1/2	0	248	249	Man in grey top
	18	S03-COUPLE_SWAP_BAG_1/2	0	234	235	Woman in red top
	19	S03-COUPLE_SWAP_BAG_1/2	756	905	150	Man in white shirt
	20	S03-COUPLE_SWAP_BAG_1/2	2581	2730	150	Man in yellow hi-viz vest and black trousers
	21	S03-COUPLE_SWAP_BAG_1/2	2706	2892	187	Woman in white jacket