CIS580 Problem Set 3

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Contents

1 Transformation to map facade to rectangle

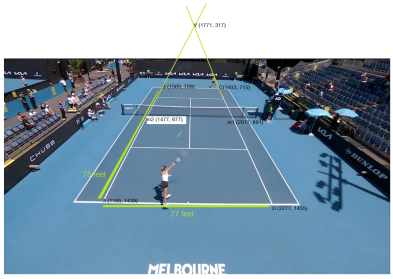
2 Compute distances of patrol car and bridge

3 Compute distances from the image

4 Different perspectives in a tennis match

- You should get the coordinates of the points in the image. To do so you can use any unit you want. Using pixels is the most convenient.
- The cross ratio should be applied in one of the baselines, and you can use the net in the middle of the court as an extra point.
- Since you have measured coordinates of A and B, you can use the similar triangle to obtain the coordinate of V.
- I had taken average of the vanishing points obtained by using cross ratio on AB and CD due to the minor differences between them.
- For each pair of sidelines you should find 1 vanishing point (so 2 in total for the two images). In the same image using the cross ratio in the two sidelines, you should get the same vanishing points (they will not be exactly the same but they will be close enough, you can just use one of them)
- For the intersection of baselines you can use intersection of lines.
- You cannot define a coordinate system where (0,0,1) is one corner and (1,1,1) is the other because you will mess the distances. In the tennis case we don't have a square. You should modify the method so that it uses [27,78,1] instead of [1,1,1]
- Oh, I see. We should use two images of the same plane, tennis court, to construct two vanishing lines and find the principle point.

4.1 Why is the perspective different



	586	1122
	1771	317
V		

	384	730
	1569	709
B		

	748	724
	1933	715
C		

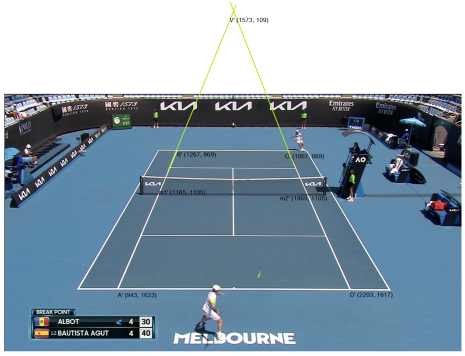
	292	562
	1477	877
M2		

	832	548
	2017	891
M1		

	0	0
	1185	1439
A		

	1092	-16
	2277	1455
D		

Distances	
AB	824.8
CD	816.0
M1C	195.0
DV	1245.4
CV	429.7



	630	1514
	1573	109
V		

	324	754
	1267	869
B		

	924	754
	1867	869
C		

	222	518
	1165	1105
M2		

	1026	518
	1969	1105
M1		

	0	0
	943	1623
A		

	1260	6
	2203	1617
D		

Distances	
AB	820.7
CD	820.0
M1C	257.1
DV	1634.3
CV	814.9

4.2 Find vanishing points using cross-ratios

Known quantities:

Units	Segment	Value
Image	AD	$\sqrt{1092^2 + 16^2} = 1092$ px
Image	BC	$\sqrt{364^2 + 6^2} = 364$ px
Image	AB	$\sqrt{730^2 + 384^2} = 825$ px
Image	CD	$\sqrt{344^2 + 740^2} = 816$ px
Image	M_1M_2	$\sqrt{540^2 + 14^2} = 540$ px
Image	$A'D'$	$\sqrt{1260^2 + 6^2} = 1260$ px
Image	$B'C'$	$\sqrt{600^2 + 0^2} = 600$ px
Image	$A'B'$	$\sqrt{324^2 + 754^2} = 821$ px
Image	$C'D'$	$\sqrt{336^2 + 748^2} = 820$ px
Image	$M_1'M_2'$	$\sqrt{804^2 + 0^2} = 804$ px
World	$AD, A'D'$	27 ft
World	$BC, B'C$	27 ft
World	$AB, A'B'$	78 ft
World	$CD, C'D'$	78 ft

Vanishing Point for Image 1

$$\begin{aligned}
\frac{DC/DV}{M_1C/M_1V} &= \frac{C_wD_w/D_wV_w}{M_{1w}C_w/M_{1w}V_w} \\
\frac{816/DV}{195/M_1V} &= 2 \cdot M_{1w}V_w/D_wV_w \\
\frac{816}{195} \cdot \frac{M_1V}{DV} &= 2 \cdot M_{1w}V_w/D_wV_w \\
\frac{195 + CV}{816 + CV} &= \frac{195}{816} \cdot 2 \cdot 1 \\
(195 + CV) \cdot 816 &= 390 \cdot (816 + CV) \\
CV \cdot (816 - 390) &= 816 \cdot (390 - 195) \\
CV &= \frac{816 \cdot 195}{426} \\
CV &= 374
\end{aligned}$$

Vanishing Point for Image 2

$$\frac{D'C'/D'V'}{M_1'C'/M_1'V'} = \frac{C_w'D_w'/D_w'V_w'}{M_{1w}'C_w'/M_{1w}'V_w'}$$
$$\frac{820/DV}{257/M_1V} = 2 \cdot M_{1w}V_w/D_wV_w$$
$$\frac{820}{257} \cdot \frac{M_1V}{DV} = 2 \cdot M_{1w}V_w/D_wV_w$$
$$\frac{257+CV}{820+CV} = \frac{257}{820} \cdot 2 \cdot 1$$
$$(257+CV) \cdot 820 = 514 \cdot (820+CV)$$
$$CV \cdot (820-514) = 820 \cdot (514-257)$$
$$CV = \frac{820 \cdot 257}{306}$$
$$CV = 689$$

4.3 Find vanishing points for court baselines

4.4 Compute the focal length of each image

4.5 Compute the vanishing points using intersection of parallel lines