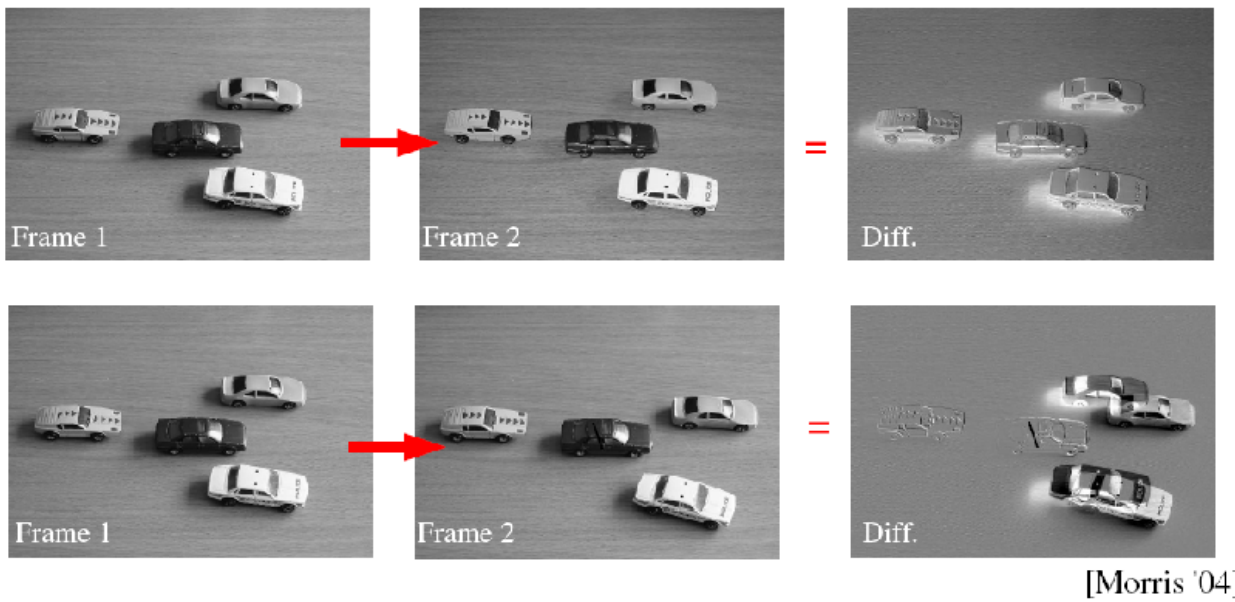
Video-Based Moving Object Detection

Robert B. Fisher
School of Informatics
University of Edinburgh

TARGET DETECTION BY IMAGE DIFFERENCING

If you don't know anything about the video other than frames are consecutive and video rate is fast compared to scene motion



[Morris '04]

Problems: Illumination changes, overlapping changes, scene vibrations

TARGET DETECTION BY BACKGROUND SUBTRACTION

If:

- Camera stationary with no autofocus/gain
- Illumination constant
- Largely isolated moving objects

use background subtraction

$$| \mathit{current} - \mathit{background} | > \mathit{threshold}$$

BACKGROUND SUBTRACTION CODE

```
% sub background & select pixels with a big difference
fore = (abs(Imwork(:,:,1)-Imback(:,:,1)) > 10) ...
   | (abs(Imwork(:,:,2) - Imback(:,:,2)) > 10) ...
   | (abs(Imwork(:,:,3) - Imback(:,:,3)) > 10);

% erode to remove small noise
foremm = bwmorph(fore,'erode',2);

% select largest object
labeled = bwlabel(foremm,4);
stats = regionprops(labeled,['basic']);
[N,W] = size(stats);
```

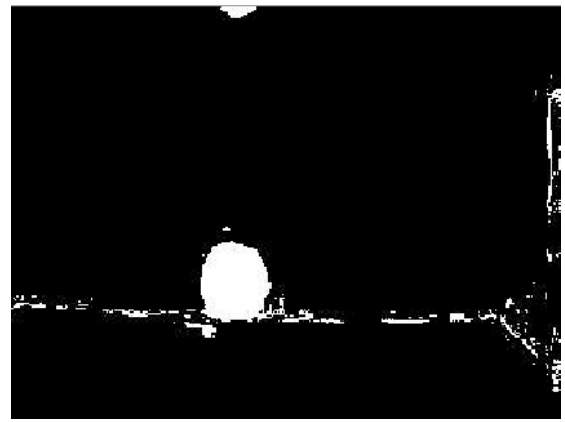
```
% do bubble sort (large to small) on regions in case
% there are more than 1
for i = 1 : N
  id(i) = i;     % aux variable to hold region id
end
for i = 1 : N-1
  for j = i+1 : N
    if stats(i).Area < stats(j).Area
      tmp = stats(i);
      stats(i) = stats(j);
      stats(j) = tmp;
      tmp = id(i);
      id(i) = id(j);
      id(j) = tmp;

% get center of mass and radius of largest
```

```
centroid = stats(1).Centroid;
radius = sqrt(stats(1).Area/pi);
```

DETECTION RESULTS

INPUT

BACKGROUND REMOVED



CLEANED

DETECTED

What's wrong?

- Moving ball blurred
- Noisy observations
- Potentially poor contrast

We can track of positions for ball in frames $0 \ldots N$

Would like ability to predict position in frame $N + 1$

So: incorporate motion model in tracker

What We Have Learned

1. Moving object detection by background subtraction or inter-frame differencing
2. Some problems that arise with the methods