RESEARCH ON RE-SHOOTING COUNTERMEASURES

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Background: analog-hole problem

Conventional problem
- Originally intended to resolve security problems with analog-output terminals of digital equipment
- Resolution by replacement of digital terminals

Rise of new problem exploiting monitors and screens
- Trend of increasingly high-quality monitors and cameras makes it easy to reshoot presented content
  -> Distribution of illegally re-shot content
  - Ex. re-shoot PC monitors with cell-phone cameras -> upload shot content
  - Ex. re-shoot theater screens -> sell pirate DVDs
    - Loss of USD 3B per year (survey of Motion Picture Association of America)
Conventional measures against re-shooting: use of digital watermarks

- Embed theater ID WM into digital cinema film.
- Detect WMs in pirate DVDs and identify flow of illegal distribution.

But: no control of re-shooting
Re-shooting countermeasure
- Objective and approach -

Objective:
- Establish countermeasure to stop re-shooting
  - No new function is added into existing user-side device (ex. cam)

Approach:
- Use of difference between sensory perceptions of humans and devices
  - Destroy shot content using invisible signals which add noise to content shot through CCD/CMOS devices
    - Employ near-infrared signals as noise signals: CCD and CMOS react to them
Properties of noise signals

- Wave length of noise signals
  - Visible range of human eyes: 380nm-780nm
  - Visible range of CCD/CMOS devices: 200nm-1100nm

- Use of near infrared LEDs
  - Infrared LEDs: no harm to human, verify safety
Prototype system

- Beamer
- Unit of infrared light emission
- 100-inch screen
Prototype system

- Movie screen: many holes (1-2mm in diameter) to combine sound and video
- Unit of infrared light emission: place on back side of screen
  - Infrared light: get through holes
- No need to modify screen

Front side

Back side