

# QUALITY OF EXPERIENCE PREDICTION FOR STREAMING VIDEO

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# Outline

- 1 **Video Streaming and Quality of Experience**
  - Video Streaming
  - Quality of Experience
  - Objective QoE Prediction
- 2 **Streaming Quality Index (SQI)**
  - Objective QoE Prediction Model
  - Experimental Results
- 3 **Conclusions**

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# The Age of Streaming



# The Age of Streaming

## Factors of Picking Streaming Service

- **Quality of Experience;**
- Content;
- Price;
- Advertisement.

# Quality of Experience

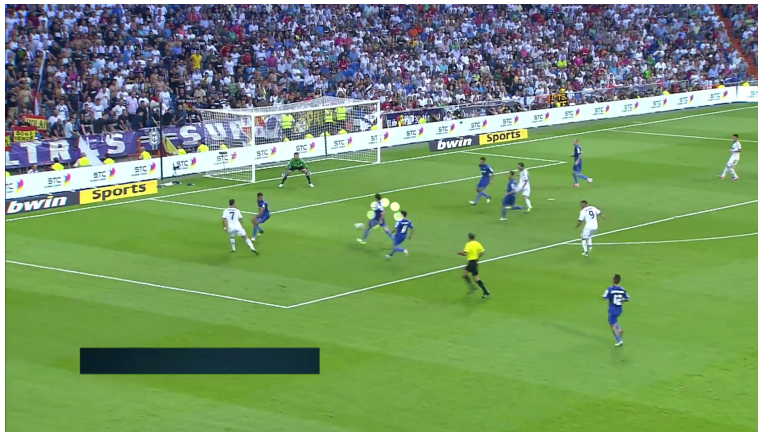
## Definition

The degree of delight or annoyance of the user of an application or service. [Callet, 2013]

# Quality of Experience

## Influencing Factors

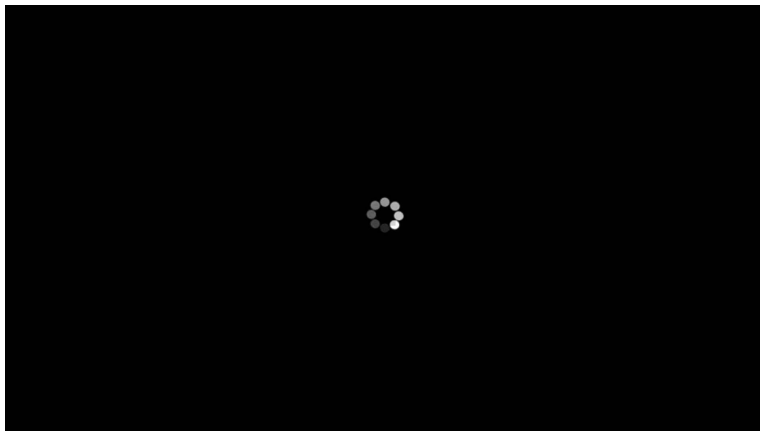
- Playback smoothness



# Quality of Experience

## Influencing Factors

- Duration of initial buffering





# Quality of Experience

## Influencing Factors

- Video presentation quality



# Interaction between Presentation Quality and Stalling Experience

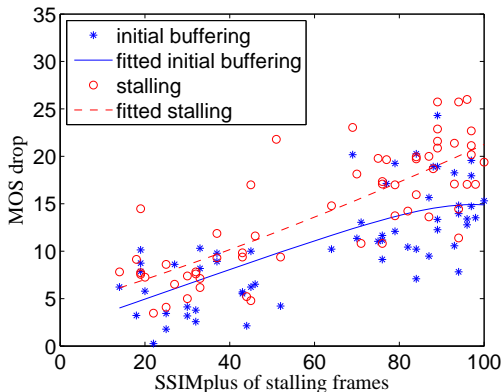
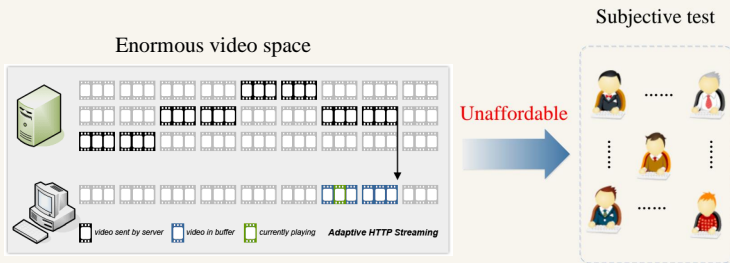


Figure: SRCC = 0.79

# Subjective QoE Prediction

## Subjective QoE Assessment



## Existing QoE models: Quality of Service-based

### Philosophy

- There exists a causal relationship between generic QoS problems and generic QoE problems.

### Factors

- Throughput -> Delivered video quality
- Stalling duration -> Waiting experience

### Existing Models

- Linear mapping [Mok, 2011];
- Exponential mapping [Hoßfeld, 2012];
- Logarithmic mapping [Rodriguez, 2012];

## Existing QoE models: Signal Fidelity-based

### Philosophy

- QoE can be measured by the distance from test video to the pristine video in the video space.

### Existing Models

- PSNR;
- SSIM [Wang, 2004];
- MS-SSIM [Wang, 2003];
- VQM [Pinson, 2004];
- SSIMplus [Rehman, 2015];

## Our method: Hybrid

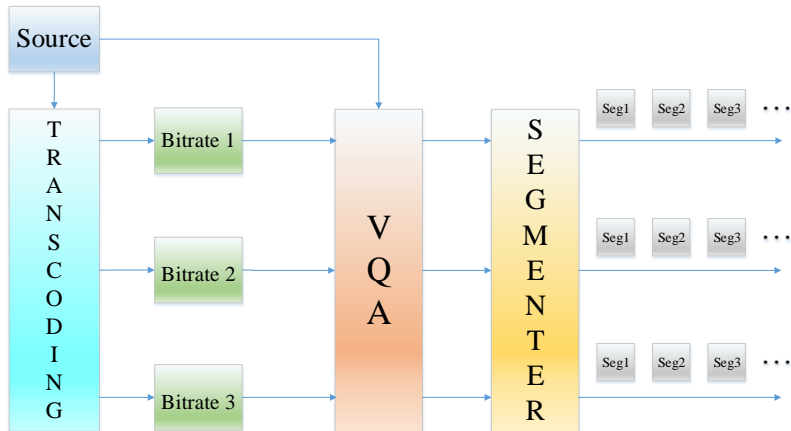
### Motivation

- QoS-based: not directly related to human perception;
- Signal fidelity-based: only work for static videos;
- No modeling on the interaction between video presentation quality and stalling.

# Outline

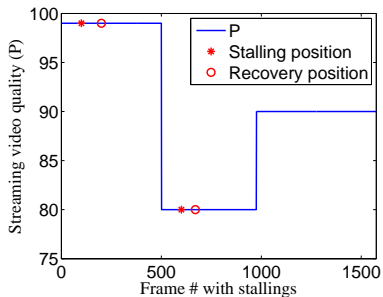
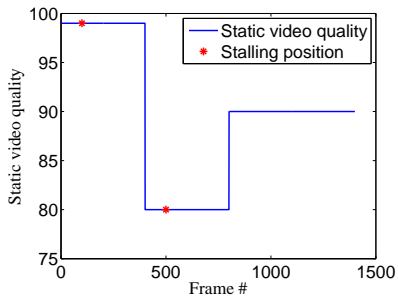
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# Presentation Quality





# Presentation Quality



# Stalling Experience Quantification

## Stalling Experience Quantification

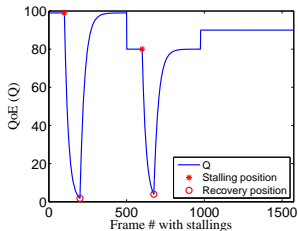
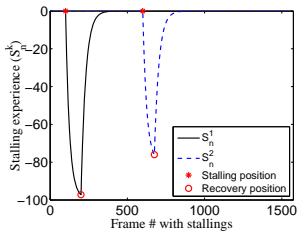
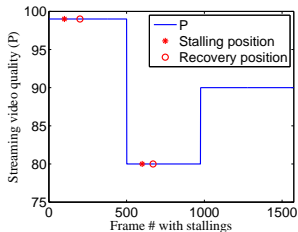
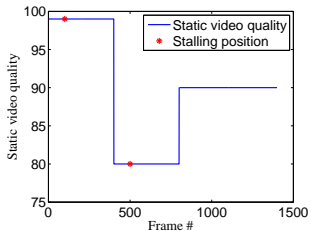
$$S^k(t) = \begin{cases} P_{i_k-1} \left( -1 + \exp \left\{ - \left( \frac{tf - i_k}{T_0} \right) \right\} \right) & \frac{i_k}{f} \leq t \leq \frac{i_k+l_k}{f} \\ P_{i_k-1} \left( -1 + \exp \left\{ - \left( \frac{l_k}{T_0} \right) \right\} \right) & \\ \cdot \left( \exp \left\{ - \left( \frac{tf - i_k - l_k}{T_1} \right) \right\} \right) & t > \frac{i_k+l_k}{f} \\ 0 & \text{otherwise} \end{cases} \quad (1)$$

# Stalling Experience Quantification

## Parameters

Parameter	Description
$T_0$	rate of dissatisfaction in stalling event
$T_1$	strength of memory in stalling event
$T_0^{init}$	rate of dissatisfaction in initial buffering event
$T_1^{init}$	strength of memory in initial buffering event
$P_0$	expectation on initial quality of the video

# Presentation Quality

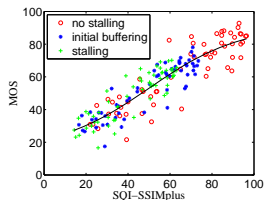
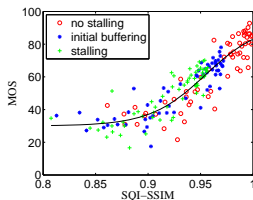
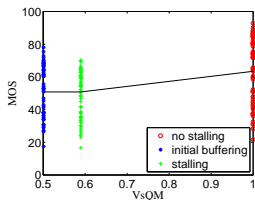
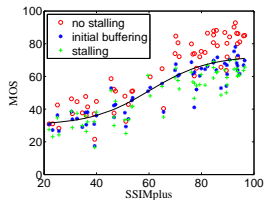
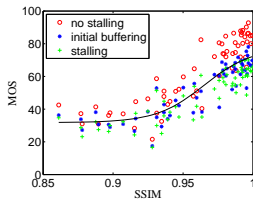
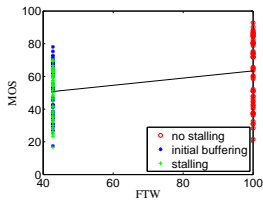


# Experimental Results

Performance comparison of QoE models on streaming video QoE database.

	PLCC	MAE	SRCC	KRCC
FTW [Hoßfeld, 2012]	0.3313	14.9455	0.3154	0.2583
PSNR	0.6663	10.7254	0.6715	0.4697
SSIM [Wang, 2004]	0.8432	7.6039	0.8177	0.6070
SSIMplus [Rehman, 2015]	0.8350	7.6934	0.8024	0.5924
SQI-PSNR	0.7391	9.8445	0.7492	0.5434
SQI-SSIM	0.9015	5.8941	<b>0.9009</b>	<b>0.7238</b>
SQI-SSIMplus	<b>0.9026</b>	<b>5.8330</b>	0.9007	0.7213

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## Contribution

- Proposed an objective QoE model for video streaming that considers presentation quality and its interaction with stalling;
- Achieved the best performance in predicting subject opinions.

## Future Work

- Construct comprehensive database;
- Investigate other QoE-related factors;
- Improve the QoE model.



## References



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*Thank you*