Empowering drones with Cinematographic Knowledge

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My research: virtual cinematography

« ***formalize* knowledge** of real cinematography into **computational models** for virtual cinematography »

But

- How to gather the knowledge?
  - *Filmakers / text-books / film-analysis*
- How to formalize the knowledge in expressive models?
  - *Expressive: powerful in the hand of users*
- How to make computational models efficient?
  - *Reducing dimensionality*

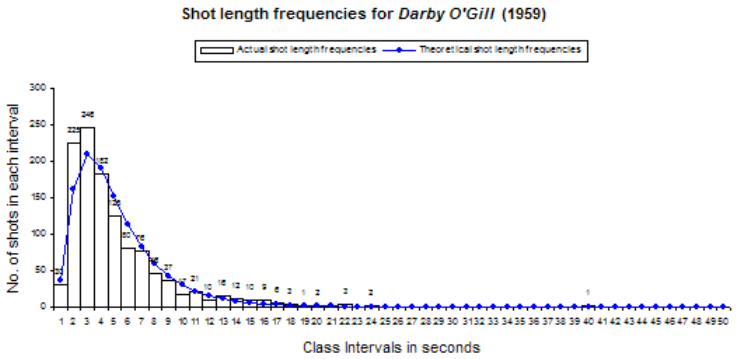
From Real to Virtual: Formalizing knowledge

- On the framing: « Hitchcock's textbook rule » the size of actors on the screen is proportional to their narrative importance in the sequence

(a) Speak (b) React (c) Manipulate (d) Move

- On the transitions between shots

- On the rythym of cuts in a sequence: the log normal law [Salt72]



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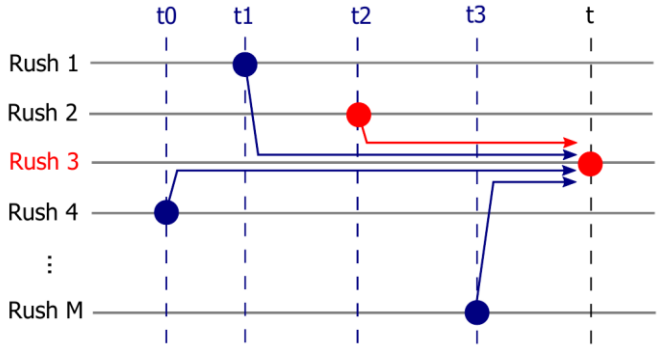
Towards automated cinematograhy

- An optimal algorithm for automated editing:
  - A film is modelled as a graph
  - A sequence is represented as a semi-markovian chain in the graph

- A cost is associated:
  - to each frame
  - to each transition
  - to the pacing (duration of shots)



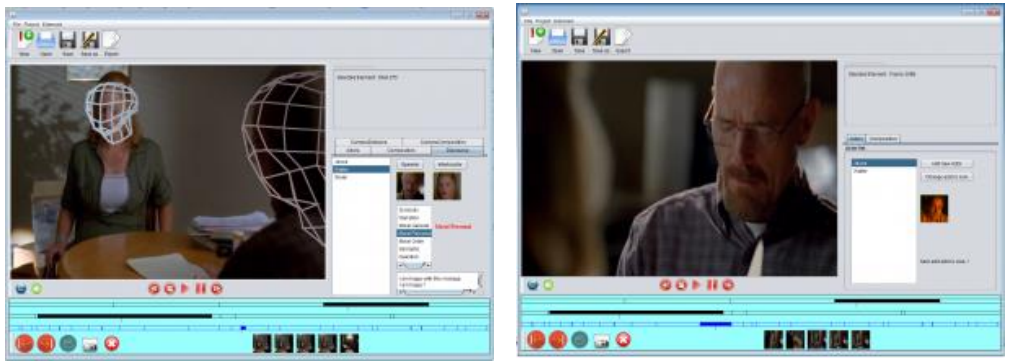
- We optimize a sequence *s* with relation to a set of actions *a*

$$C(s,a) = \sum_{j} \sum_{t_j \le t \le t_j + d_j} C^A(r_j, t) + \sum_{1 \le j} C^T(r_{j-1}, r_j, t_j) + \sum_{j} C^R(d_j)$$

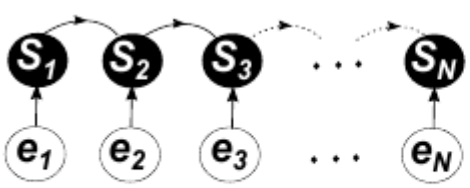
Action cost (Shot quality) | Transition cost (Cut quality) | Rhythm cost (Pacing Quality)

Analysis of real movies

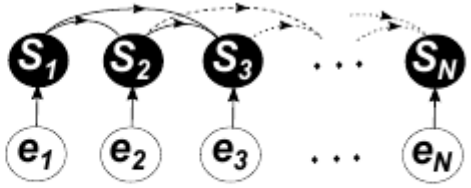
- Encoding **RULES** is not encoding **STYLE**
- We propose:
  - feature extraction from real movies



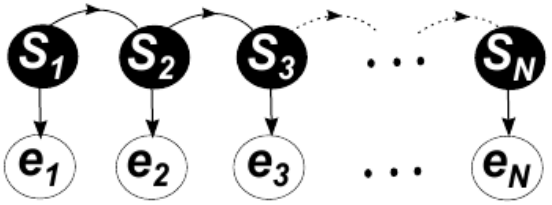
  - learning techniques (learning probabilities of transitions between movies) base on a Hidden Markow Model representation



a) first order dependency shots.

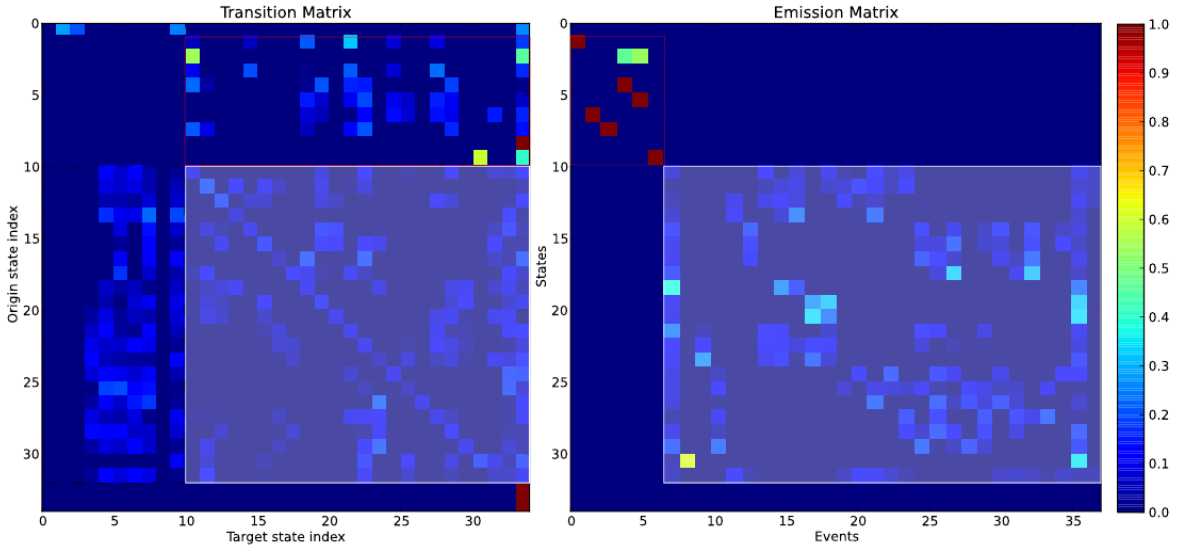


b) second order dependency shots.



How to reduce a filmaker to 2 matrices?

- Transition matrices (between framings) and emission matrices (associating actions/framings)



States: 1.init 2.set(2actors) 3.set(1actor) 4.update(2act) 5.update(Xact) 6.update(Yact) 7.update(Up) 8.update(Down) 9.invert() 10.update(Symb) 11.fullBody(X) 12.medium(X) 13.close(X) 14.extCloseUp(X) 15.fullBody(Y) 16.medium(Y) 17.close(Y) 18.extCloseUp(Y) 19.fullBody2Shots(X) 20.Medium2Shots(X) 21.CloseUp2Shots(X) 22.FullBodyOverShoulder(X) 23.medOverShoulder(X) 24.closeOverShoulder(X) 25.fullBody2Shots(Y) 26.medium2Shots(Y) 27.close2Shots(Y) 28.fullBodyOverShoulder(Y) 29.medOverShoulder(y) 30.closeOverShoulder(Y) 31.symbShot(A) 32.overAllShot() 33.final

Events: 1.update(X,Y) 2.updateUp(X,Y) 3.updateDown(X,Y) 4.update(X) 5.update(Y) 6.update(S) 7.neutral 8.symbolic(S) 9.sementic(X,Y) 10.sementic(Y,X) 11.sementic(X,All) 12.sementic(Y,All) 13.narration(X,Y) 14.moralGle(X,Y) 15.moralPle(X,Y) 16.moralOrder(X,Y) 17.question(X,Y) 18.narration(X,All) 19.moral-Gle(X,All) 20.moralPle(X,All) 21.moralOrder(X,All) 22.question(X,All) 23.narration(Y,X) 24.moralGle(Y,X) 25.moralPle(Y,X) 26.moralOrder(Y,X) 27.question(Y,X) 28.narration(Y,All) 29.moralGle(Y,All) 30.moralPle(Y,All) 31.moralOrder(Y,All) 32.question(Y,All) 33.indetemined() 34._nar(X,All) 35._mgl(X,All) 36._mpl(X,All) 37._mor(X,All) 38._que(X,All) 39._sem(X,All)

From Virtual to Real (ongoing work)

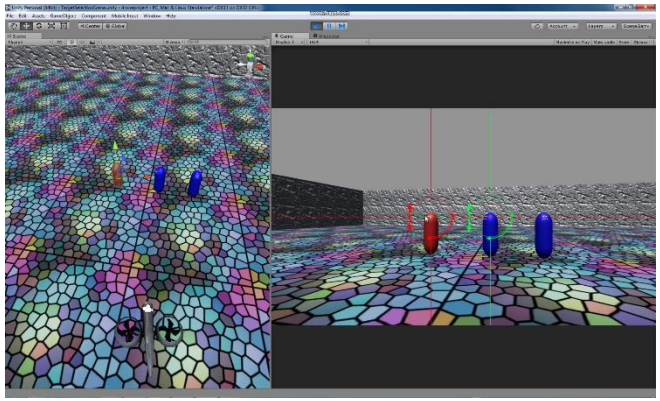
- Can we loop the loop? And make results on virtual systems impact real ones?
  - Quality and weight of cinematographic cameras have dramatically changed over the decade (eg Alexa ARRI 4K cameras)
  - Drones are stable and have important lift capacities
- Empowering drones with cinematographic knowledge!
  - Improving the (cinematographic) control of drones
  - Coordinating cinematographic drones as a film crew

Cinematographic drones

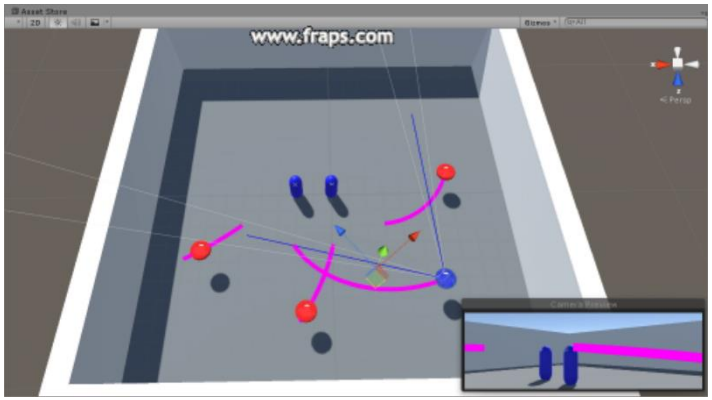
- Drones able to understand cinematographic knowledge [Galvane16]
  - Orders given in the Propose Storyboard Language [Ronfard13]

(Courtesy from Technicolor)

- Expressive cinematographic drones



- Autonomous cinematographic drones



Wrap up

- Ongoing work on empowering drones with cinematographic knowledge
  - Formalizing knowledge of movies in computationnal and expressive models
  - Adapting the models from virtual environments to real environments
- Live experimentation in August!