# Kilix: Heterogeneous Modeling of Gesture-Based 3D Applications

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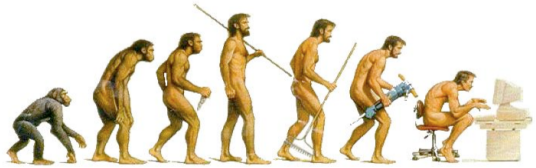


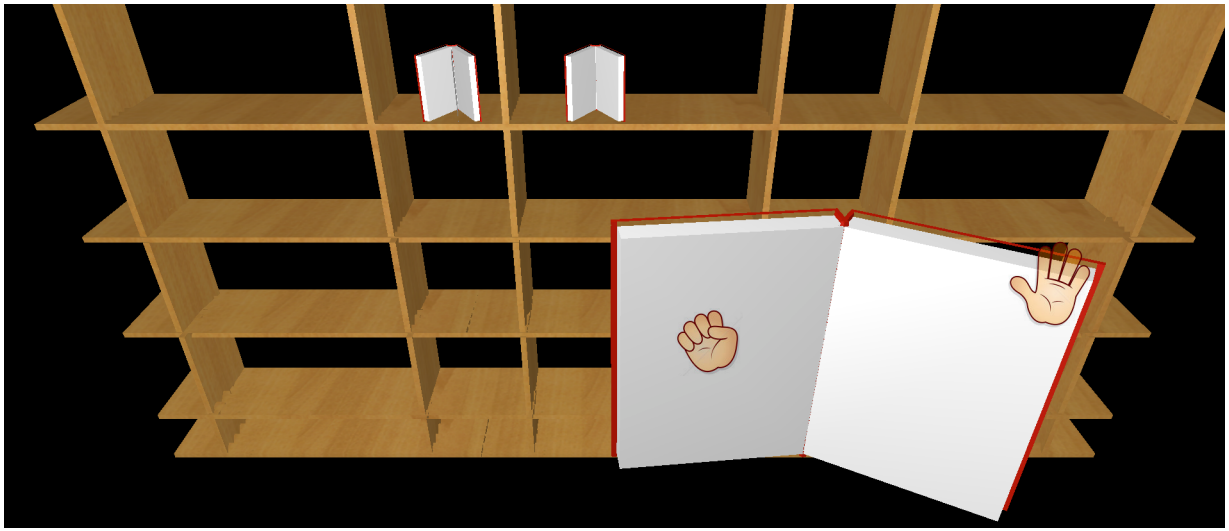
# Goals of our research

- Reduce complexity of developing HCI applications
  - By using visual modeling instead of programming
- Assess the usability of heterogeneous modeling for this purpose
- Evaluate the strengths and shortcomings of *ModHel'X*, a heterogeneous modeling environment
  - Explore and improve its notions of *semantic adaptation*

wwwdi.supelec.fr/software/ModHelX
wwwdi.supelec.fr/software/ModHelX/Kilix

# Case study

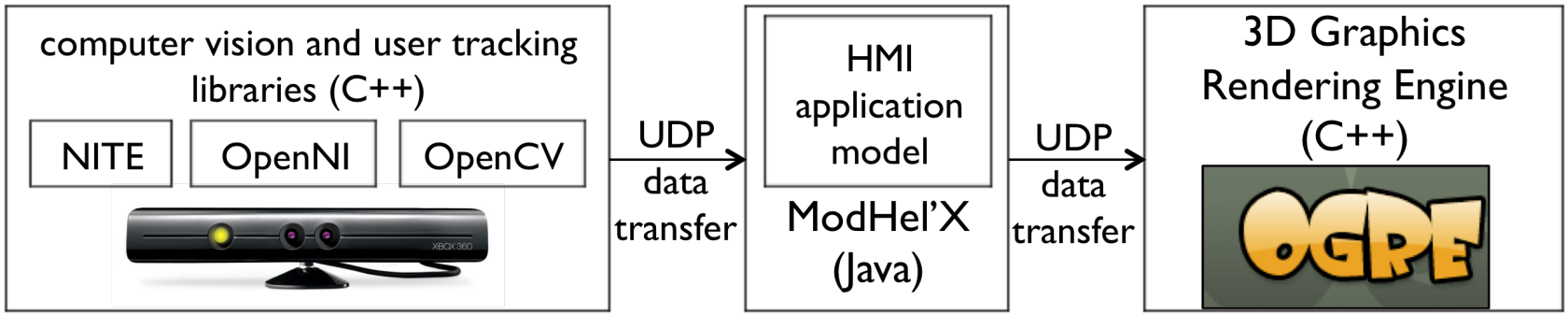
- Gestural interaction with a graphical 3D application
  - Using the *Kinect* controller to interact with virtual books using hands only

# Proposed architecture



- Client-server architecture
  - Low coupling between I/O devices and user interaction models




- Combining different models of computation (*MoC*)
  - choose the most appropriate formalism for the task at hand
    - *discrete events (DE)*
    - *synchronous data flow (SDF)*
    - *timed finite state machines (TFSM)*

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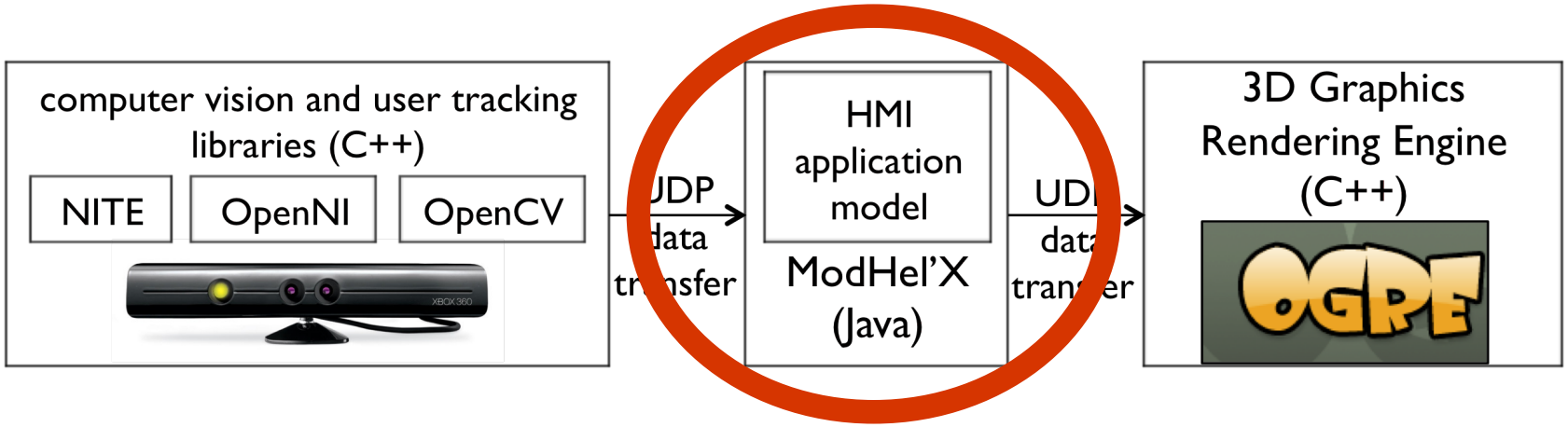


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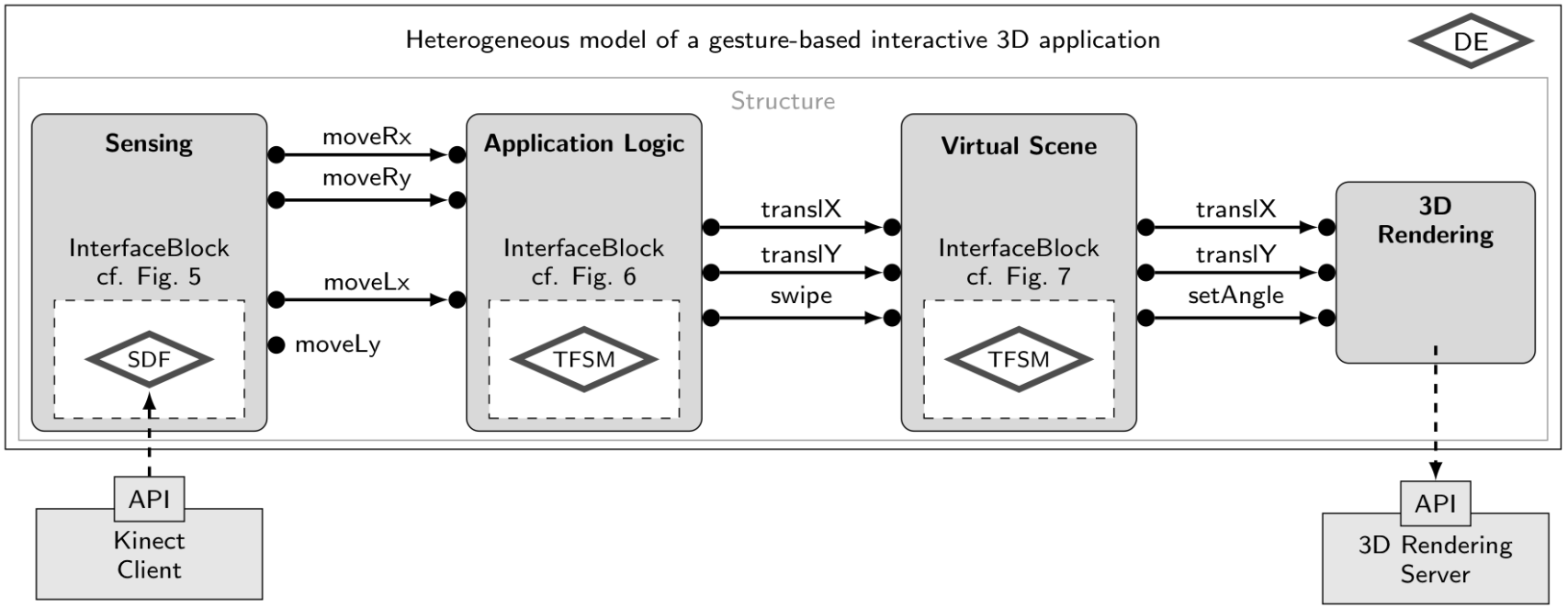
# Heterogenous modeling

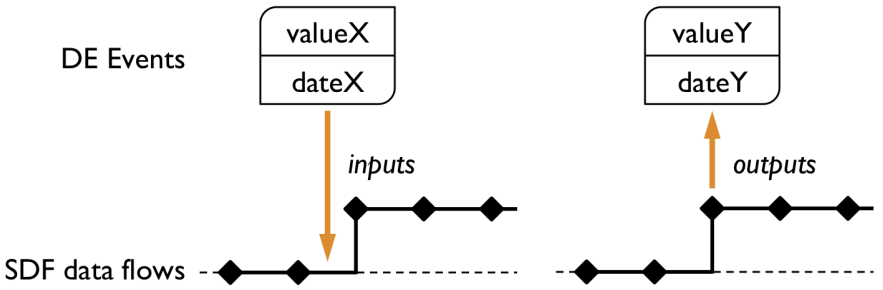
- Hierarchical architecture
- Top-level model contains 4 blocks
  - *MoC* is discrete events *(DE)*
  - communication through timestamped events containing data

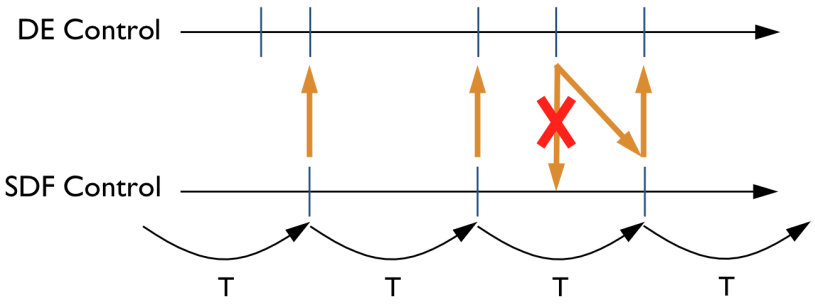


# Semantic adaptation



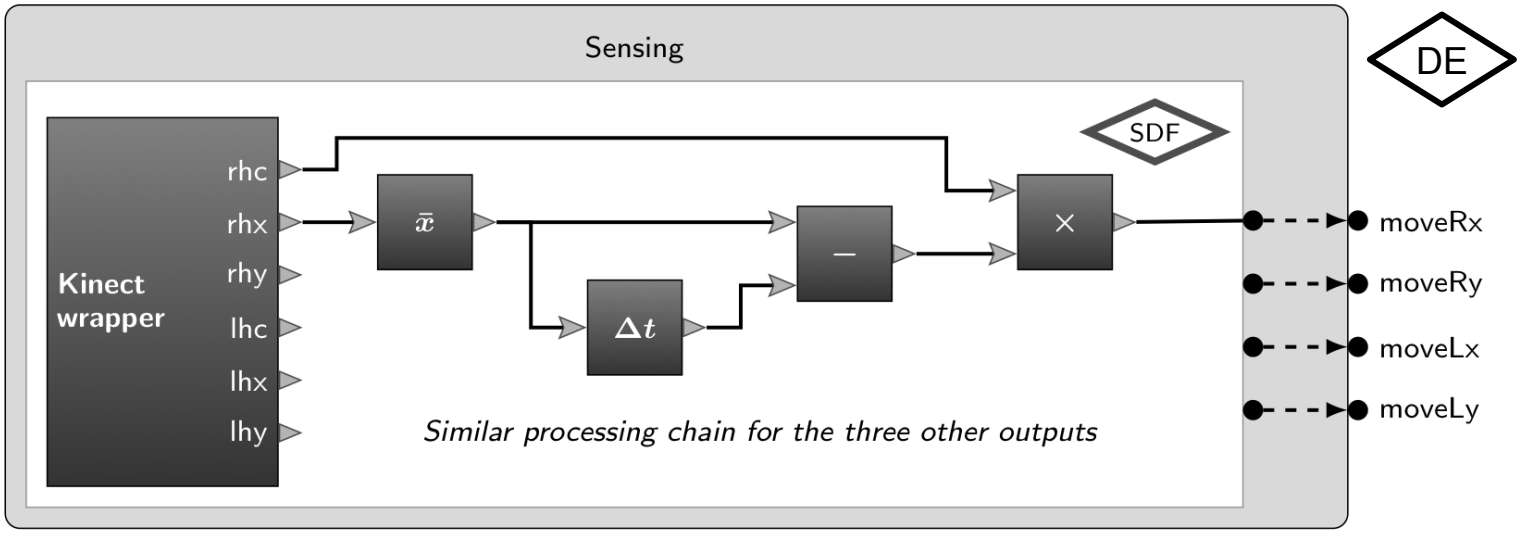
- Interface blocks *adapt* the *semantics* between outer and inner models using different models of computation
- Adaptation can be made to
  - *Data* (which may be represented differently)
  - *Time* (e.g. different time units, different time scales, continuous vs discrete time)
  - *Control* (trigger observations of the internal model at instants requested by the internal MoC)



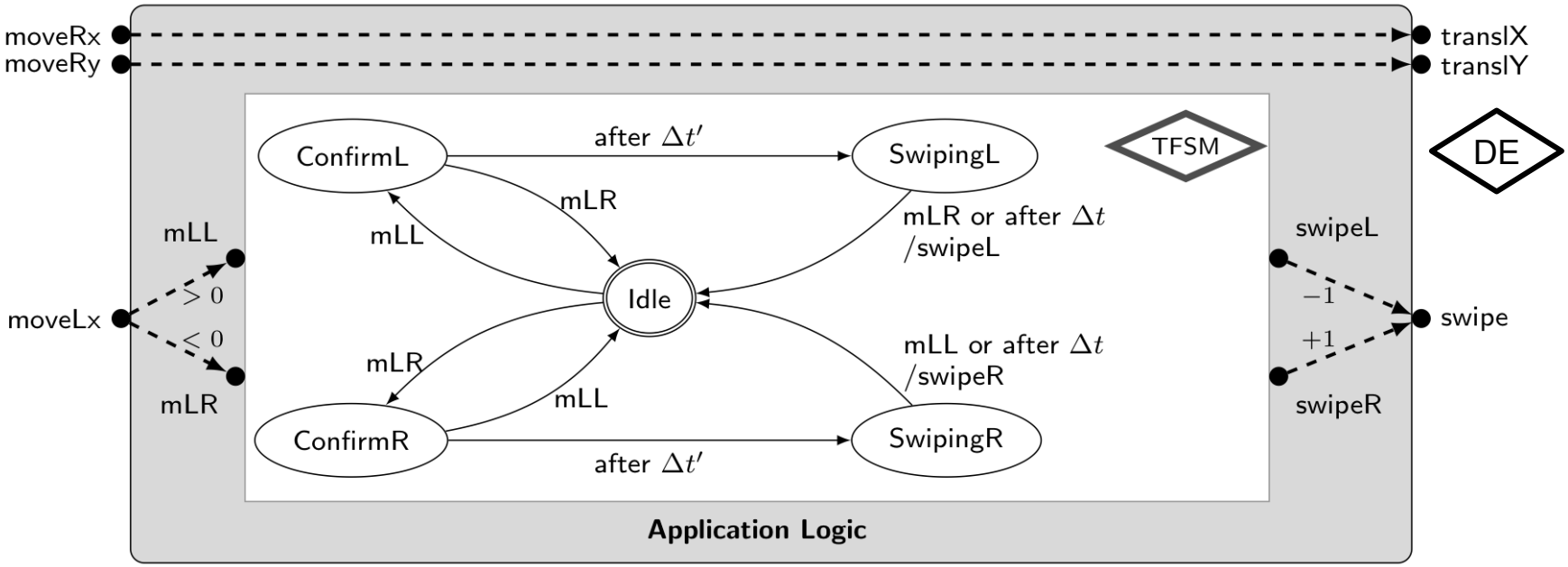
# Sensing block

- Receives data from *Kinect* and converts it into hand gesture events
- MoC = synchronous data flow (SDF)
  - Processes a chain of sampled signals received from *Kinect* at a fixed rate
  - Semantic adapter generates DE events when non-null SDF tokens are produced



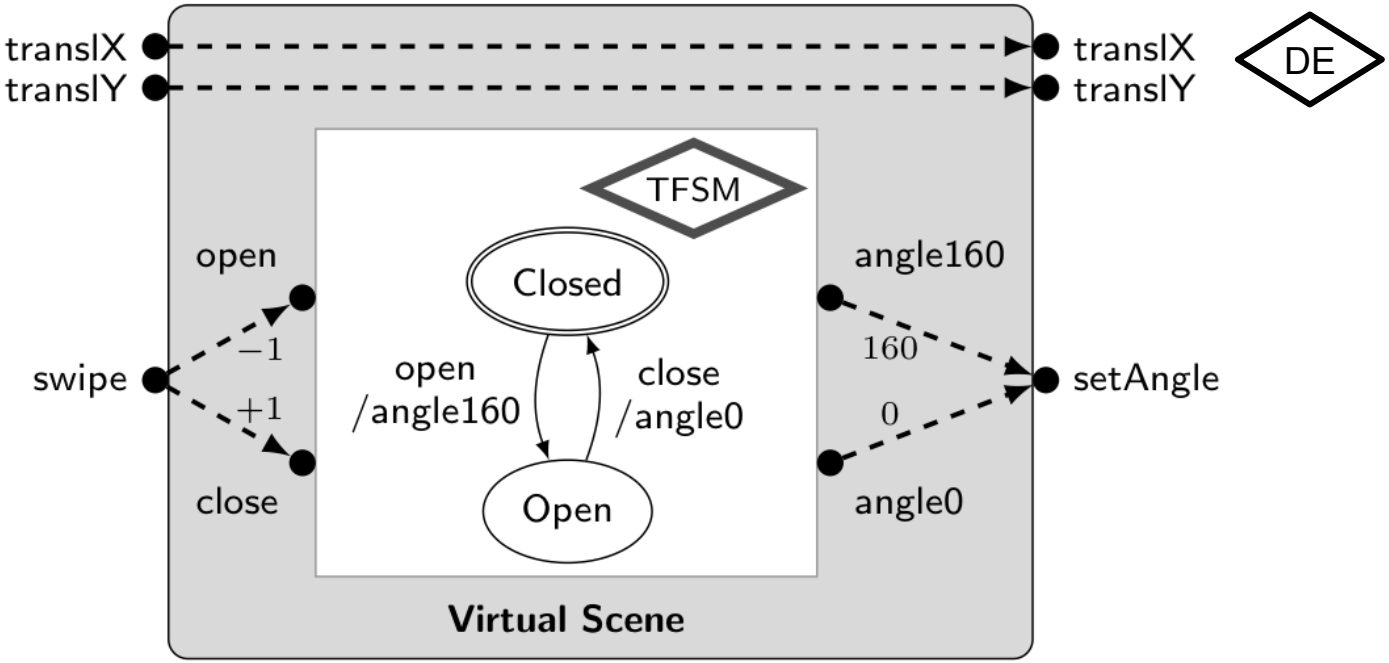
# Application Logic block

- Interprets and converts hand gestures into meaningful actions for 3D object manipulation
  - MoC = timed finite state machines (TFSM)
  - DE/TFSM adapter converts between DE events and symbols for the state machine



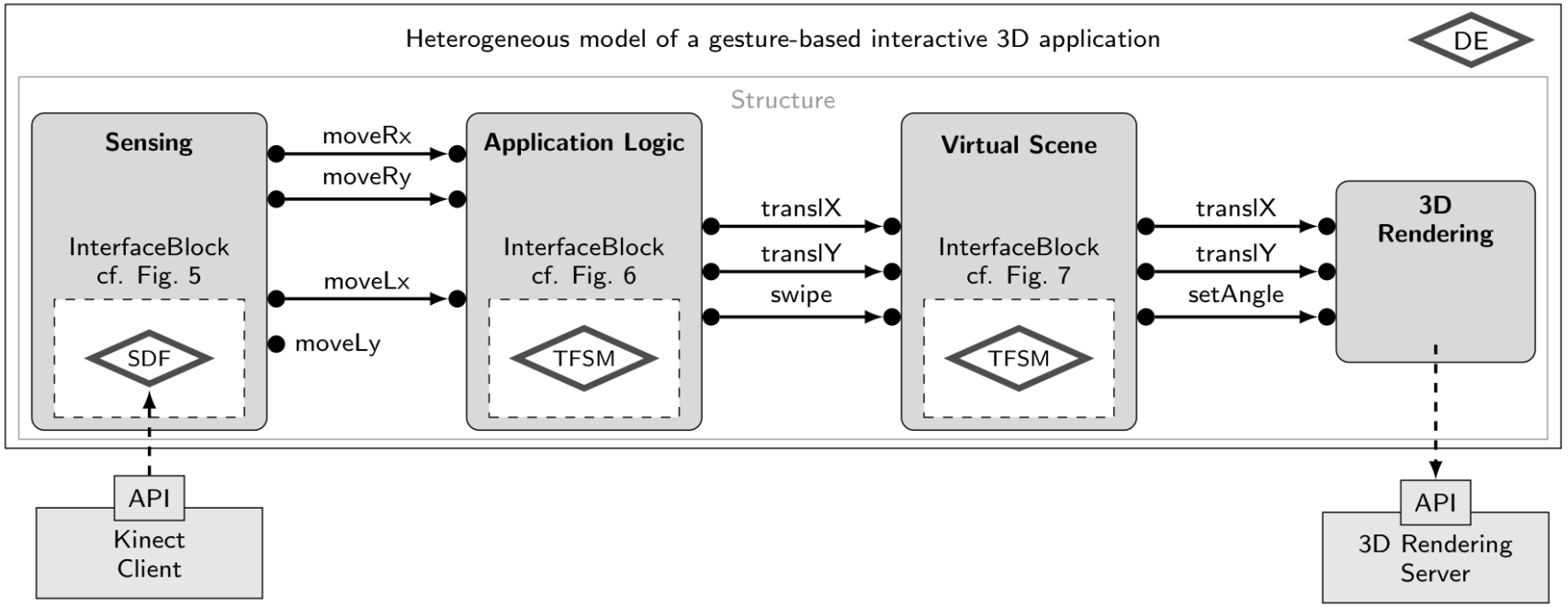
# Virtual Scene block

- Represents graphical 3D objects (e.g., book) that interpret the actions as object-specific behaviour (e.g. opening or closing the book)
  - MoC = TFSM



# Heterogenous modeling

- General overview revisited



# Discussion

- Heterogeneous modeling is useful for HCI applications
- Semantic adaptation can be used
  - To adapt between models of computation
  - To map application actions (e.g., swipe) to object behaviors (e.g., open or close)
  - To use the same component differently in different applications
    - Leads to less coupling and higher component reusability
- Dynamic modeling is difficult to achieve
  - e.g. variable number of users and books at runtime

# Future work

- Compare strengths and weaknesses of *homogenous* and *heterogenous* modeling
  - Based on common case study
  - Expressed using statecharts only
  - Expressed using high-level Petri nets
    - Joint work with Ph. Palanque, Toulouse (PetShop tool)
  - Expressed using ModHel'X
- ModHel'X improvements
  - Performance issues
  - Add support for visual editing of models
  - Support domain-specific languages to match the application domain better (work in progress)
  - Extend existing MoC (TFSM++)

# References

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