

Thoughts on FML: Behavior Generation in the Virtual Human Communication Architecture

Jina Lee¹, David DeVault², Stacy Marsella¹,
David Traum²

¹ Information Sciences Institute, University of Southern California

² Institute for Creative Technologies, University of Southern California



Implementing SAIBA Framework

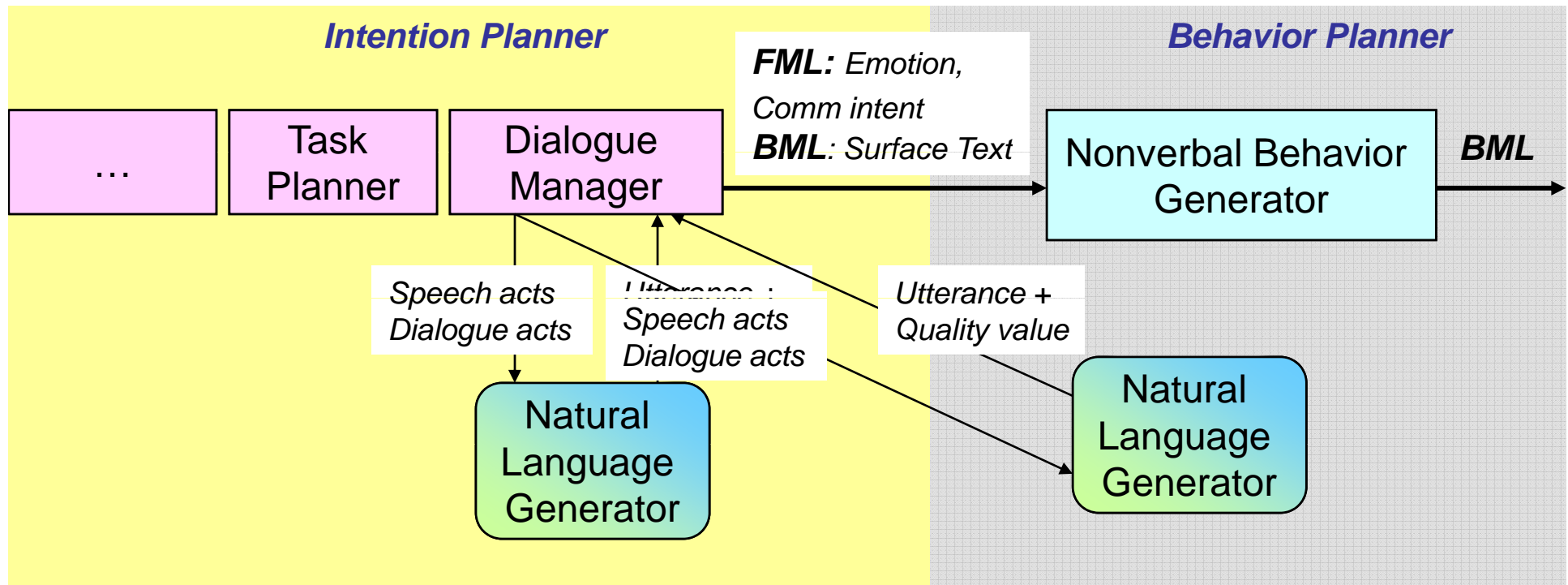
- SAIBA Framework
 - Clear distinction between intention planning, behavior planning, behavior realization
 - BML is well-developed
 - FML under progress
- Overview – Issues regarding FML
 - Architectural issues
 - FML compatibility with different theories
 - Issues with real-time environment
 - Displaying agent's intention: intended vs. unintended

1. Architectural Issues

- FML: Intended to specify agent's communicative intent, affect
- However, certain behaviors are closely tied to a wide range of internal cognitive state
 - e.g. Natural language generation, Gaze movement
- [Body state, External state of the world]
- Should FML be the pathway for all the factors influencing those behaviors?
 - e.g. agent's goal, communicative intent, goal status, speech act, dialogue act, world state, etc.

Architectural Issues – Natural Language Generation

- Current Approach: NLG occurs before NVB generation
- Dialog manager initiates NLG by sending generation request to external generator
 - Four external generators: two statistical, hand-crafted grammar-based, hybrid generator



Language Generation and FML - Challenges

- Our perspective: NLG should be viewed as part of **behavior planning**
 - Language use is a planned *behavior*
 - Advantages in naturalness and efficiency of communication when planning verbal and NVB simultaneously
- Challenges followed
 - NLG requires rich input specifications to achieve high quality output (e.g. referring expression)
 - FML needs to describe exhaustive description of context
 - Or the generator would need some other mechanism by which upstream modules can be queried
- Different realizers may expect different inputs
 - FML scheme has to be compatible with and easily converted into particular inputs

Architectural Issues - Gaze

- Key Principle behind our gaze model
 - Gaze should reflect the agent's underlying cognitive state
 - Located within cognitive module
- A set of cognitive operators generated by the cognitive module drives the gaze behaviors
 - Operators related to *conversation regulation, update of internal cognitive state, monitoring of events/goal status, coping strategy*
- Preliminary use of FML <gaze>
 - Specify physical properties of gaze & functional role
 - Gaze type, Target, track, Speed, Priority, Reason

```
<fml><gaze type="focus" target="doctor-perez" track="1"
  speed="slow" >listen_to_speaker </gaze></fml>
```

- FML <gaze> is transformed into BML <gaze> by the behavior planner (NVBG)

Architectural Issue - Gaze

Category	Cognitive Operator	Gaze Reason
Conversation Regulation	output-speech	<ul style="list-style-type: none"> - planning_speech_(look_at_hearer, hold_turn, rejection, rejection_goal_satisfied, acceptance_reluctant, remembering) - speaking - speech_done - speech_done_hold_turn
	listen-to-speaker	- listen_to_speaker
	interpret-speech	- interpret_speech
	expect-speech	- expect_speech
	wait-for-grounding	- expect_(acknowledgment, expect_repair)
Update Internal Cognitive State	update-desire update-relevance update-intention	- planning
	update-belief	- monitor_goal
Monitor for Events / Goal Status	attend-to-sound	- attend_to_sound_object
	check-goal-status	- monitor_goal
	monitor-goal-status	- monitor_goal_refresh
	monitor-for-expected-effect	- monitor_for_expected_effect
	monitor-for-expected-action	- monitor_expected_action
Coping Strategy	Coping-focus	<ul style="list-style-type: none"> - monitor_expected_action (assert intention to perform the action, (take action against an action)) - seek_social_support monitor_goal - avoidance - convey_displeasure - accept_responsibility - make_amends - resignation - avoidance (by-distancing, by-wishing-away)

Gaze and FML – Challenges and Suggestions

- Moving gaze model to the behavior planner
 - Why: Gaze is behavior!
 - FML needs to provide rich information on internal cognitive state
- Suggestions:
 1. Expand 'Reason' of gaze
 - Reason: a token describing the rationale behind why we are doing the gaze
 - Expand this to include fine-grained detail
 - Different behavior planners can represent the same communicative intent with varying expressivity
 2. Break down <fml> gaze according to categories of cognitive operators
 - Conversation Regulation, Update Internal Cognitive State, Monitoring, Coping Strategy
- Key point: FML must convey rich context, not just the communicative intent

2. FML Compatibility Issue

- Already mentioned
 - Different input requirements for different NLG realizers
- There may be several theories for the same human phenomena
 - E.g. Theories on emotion
- Should FML be
 - General enough to be compatible to every theoryor
 - Specific to a particular theoryor
 - Sub-specifications for different theories

FML Compatibility Issues – Emotion

- Preliminary Use of FML <affect>
`<affect type="joy" intensity="1.0" target="captain-kirk" stance="leaked" />`
- In-progress: alternative ways to express affect
 - In accordance with categorial emotion theory and appraisal theory
 - Represent emotion labels (categories)
`<affect type="joy" intensity="1.0" target="captain-kirk" />`
 - Represent appraisal dimensions
`<affect type="appraisals" target="captain-kirk" />
 <appraisal type="desirability" value="0.2" />
 <appraisal type="novelty" value="0.4" />
</affect>`
- Others: Russell's PAD model

3. Issues with Real-time Environment

- Agents residing in dynamic environment
 - Must respond to unexpected events
 - Monitor expected events, goal status
- We need feedbacks & callbacks
 - Intention planner may want to adjust or cancel commands scheduled, but not yet executed
 - Need a pathway from behavior planner to the cognitive module
- Are they in FML?

4. Issues with Displaying Agent's Intentions

- Three types of Intentions [Allwood]
 - Indicate: Information conveyed without conscious intention
 - Display: Information consciously shown
 - Signals: Conscious showings of the showings (intended for the receiver to recognize them)
- Questions
 - Should every action (including unintended showings) be part of FML/BML pathway?
 - Should there be some other pathway from the cognitive module to the behavior planner
- Agent's state
 - e.g. breathing, sweating, being agitated
 - Does FML convey only communicative intents or should it be a general path for everything between intention planner and behavior planner?
 - Whose communicative intent is it? (designer's vs. agent's)