

HCI Design in the OR: A Gesturing Case-study

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Motivation

- Usability of computerized systems is influenced with their accessibility via a proper human computer interface (HCI)
- User interaction requirements in the operating room (OR) are highly dependent on the usage context, e.g. surgery type and surgeons' decisions
- Surgeons are limited to predefined user interfaces (UI)
- The concept UI customization has been studied in other domains [1-3]

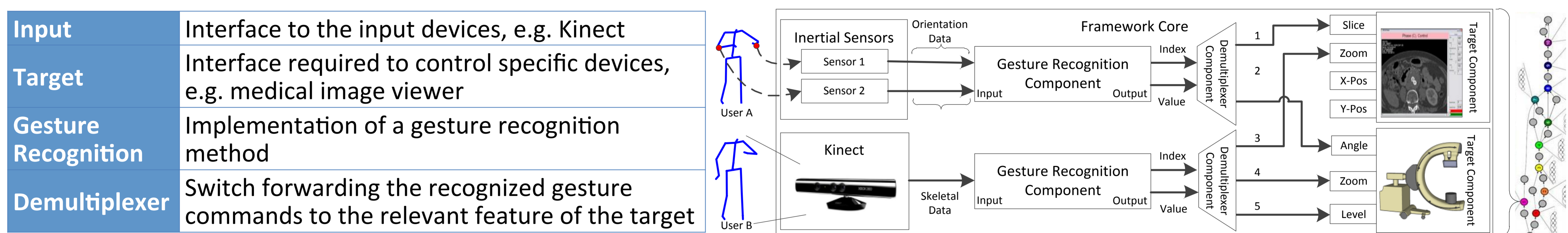
Contribution

- A HCI designing framework specific for the operating room (OR)
 - considering the main intra-operative aspects [4]
 - standalone
 - not hardcoded in the medical solution itself
- A methodology for utilizing such HCI designing concepts in practice
- Gesture-based interfaces as an example

Clinical Use-Case Stent Implantation

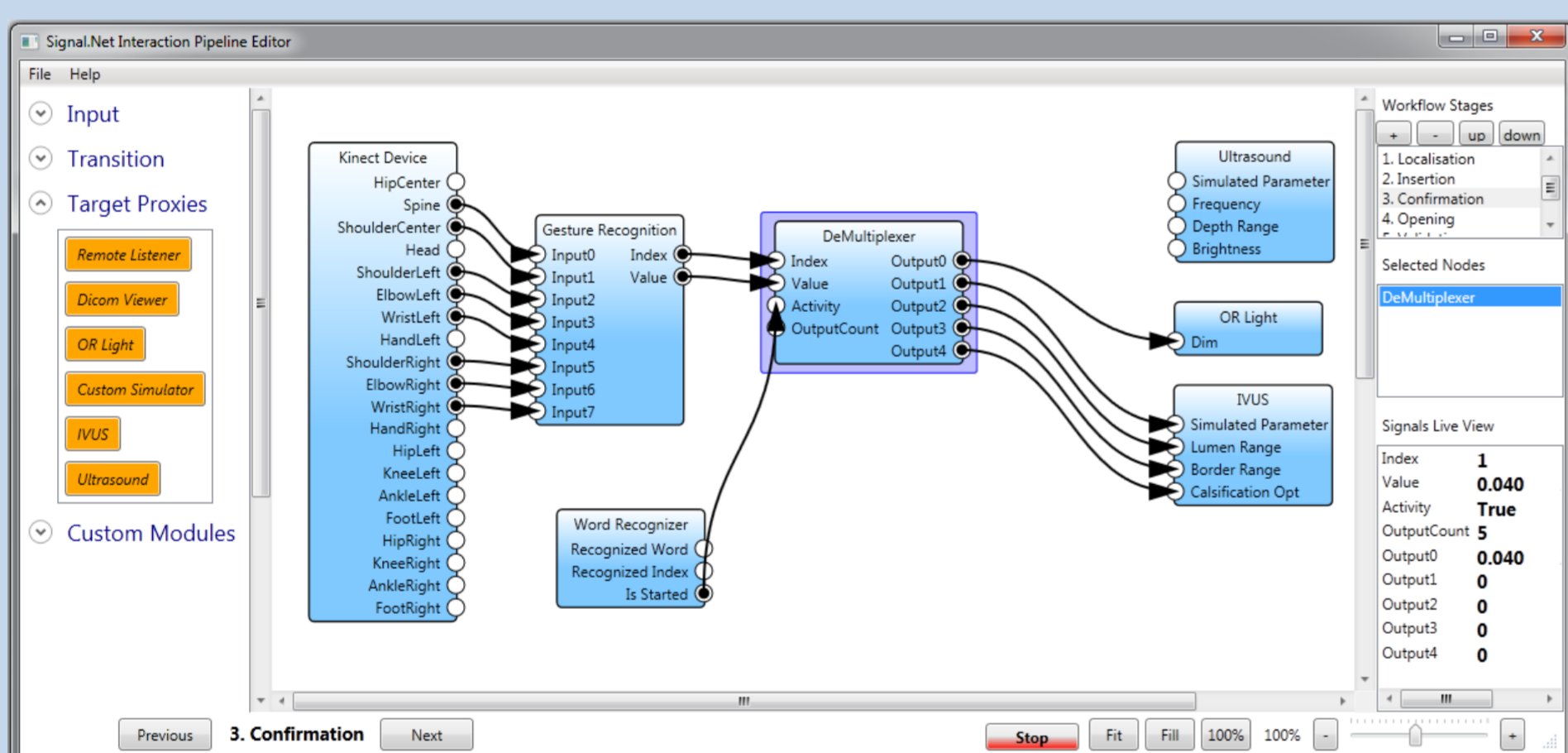
Surgical Stage	Available Devices
Find insertion point for catheter	• Ultrasound
Insert catheter, guide wire and stent	
Confirm correct placement	• Angiography • IVUS
Open stent	
Validate placement and opening	• Angiography • CTA

Framework Architecture



Input	Interface to the input devices, e.g. Kinect
Target	Interface required to control specific devices, e.g. medical image viewer
Gesture Recognition	Implementation of a gesture recognition method
Demultiplexer	Switch forwarding the recognized gesture commands to the relevant feature of the target

Visual Editor



- drag-and-drop
- XML-based load/save
- customizable based on:
 - each user
 - each workflow stage
 - each target system

Methodological Approach

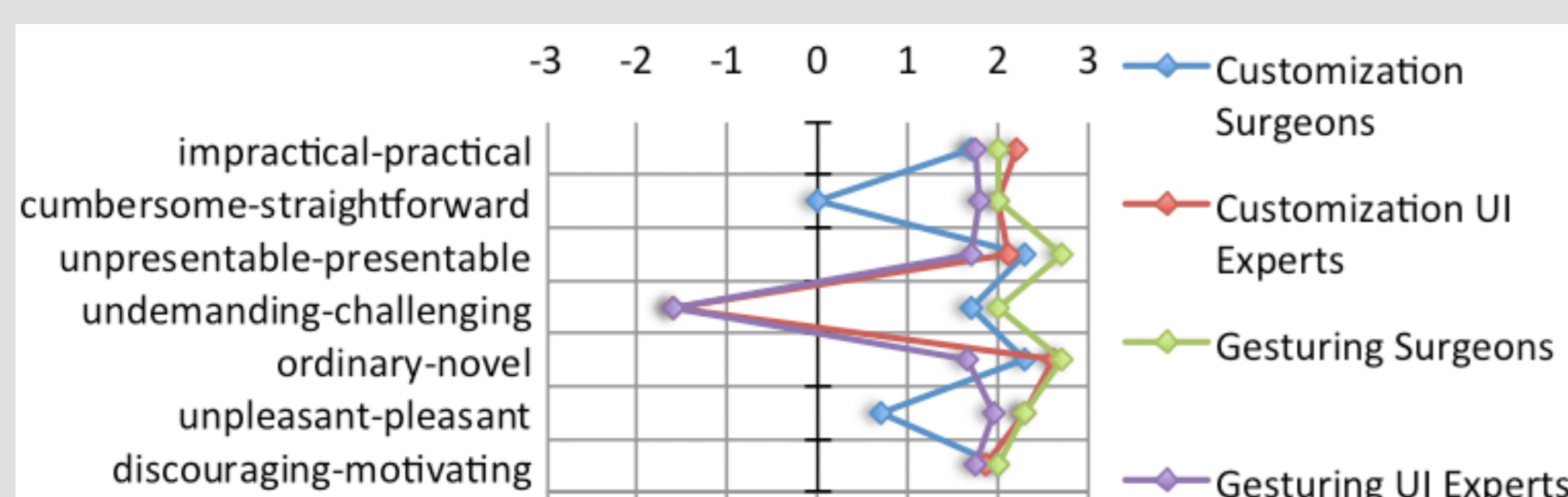
Plan	• Define interaction requirements
Design	• Define interaction pipelines using the visual editor
Interact	• Load configuration and update • Provide a subset of features to the user in recognized workflow stage

User Studies

	UI Experts	Surgeons
# participants:	18	1 assistant 1 senior 1 chief
age:	mean: 35.5 σ: 8.5	31, 39 and 49 respectively
experience:	mean: 9.1 years σ: 5.3 years	3, 13 and 25 years respectively

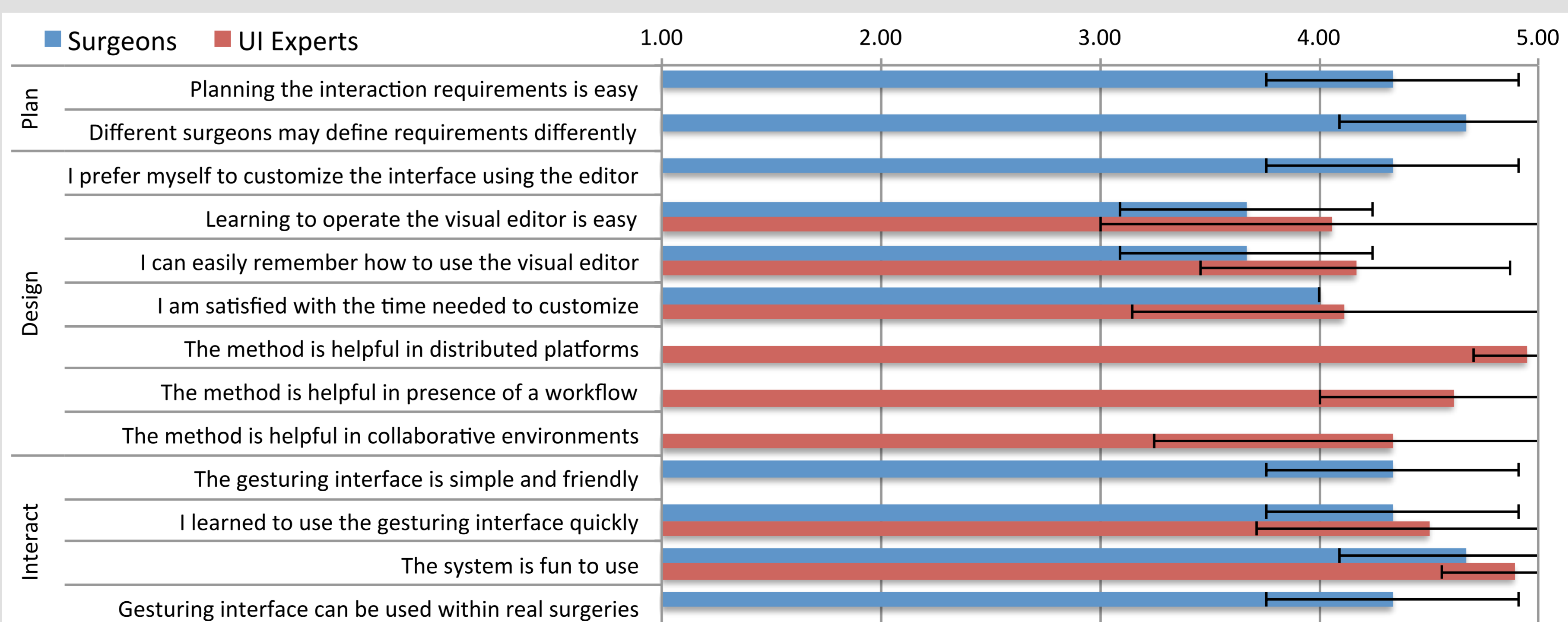
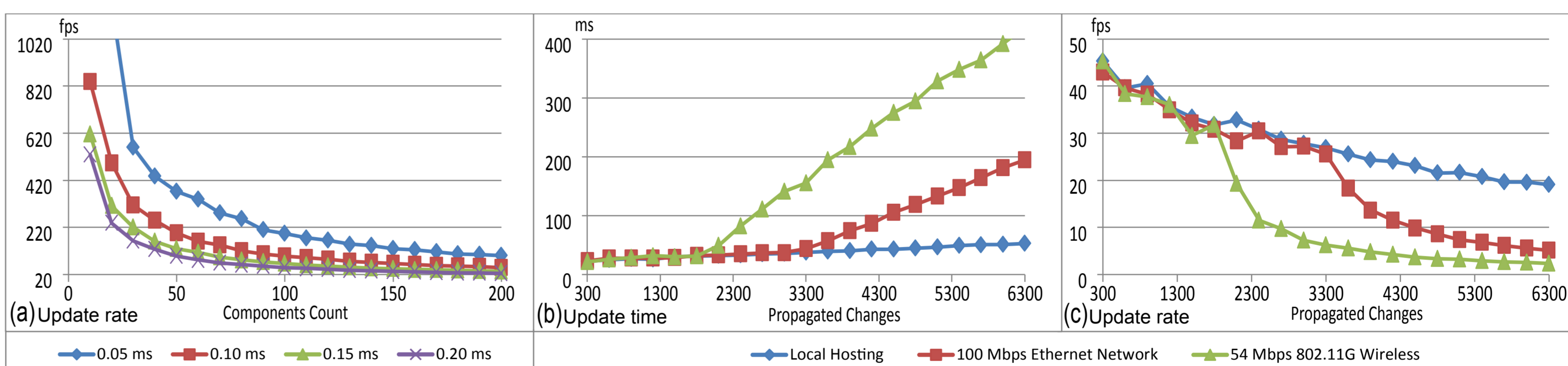
UI Experts	too self-oriented	self-oriented	desired	Surgeons	too self-oriented	self-oriented	desired
		neutral	task-oriented			neutral	task-oriented
	superfluous		too task-oriented		superfluous		too task-oriented
pragmatic quality (PQ)				pragmatic quality (PQ)			

G Medium value of "OR Gesturing" Confidence rectangle
C Medium value of "OR Customization" Confidence rectangle



Performance Evaluation

- 2.5 GHz Intel Core 2 Duo with 4 GB RAM
- 1 min runs for each configuration
- automatically generated pipelines with different number of components



[1] Dumas et al. A toolkit for rapid prototyping of multimodal interfaces, ICMI 2009.

[2] Serrano et al. A three-dimensional characterization space of software components for rapidly developing multimodal interfaces, ICMI 2008.

[3] Bourguet et al. A toolkit for creating and testing multimodal interface designs, UIST 2002.

[4] Bigdelou et al. OR specific domain model for usability evaluations of intra-operative systems, IPCAI 2011.