Interface-Aware Intelligence for Robot Teleoperation and Autonomy

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For a human to issue control signals to a robot platform requires *physical actuation* of an interface.

However, robot control systems overwhelmingly are agnostic to interface source and actuation mechanism.

Our premise: When robot systems that depend on human input do not consider the physical source of the human control signal—characteristics of the interface actuation mechanism, limitations on the signal transmission, capabilities of the human operator—a fundamental, and artificial, upper limit on team synergy and success is imposed.

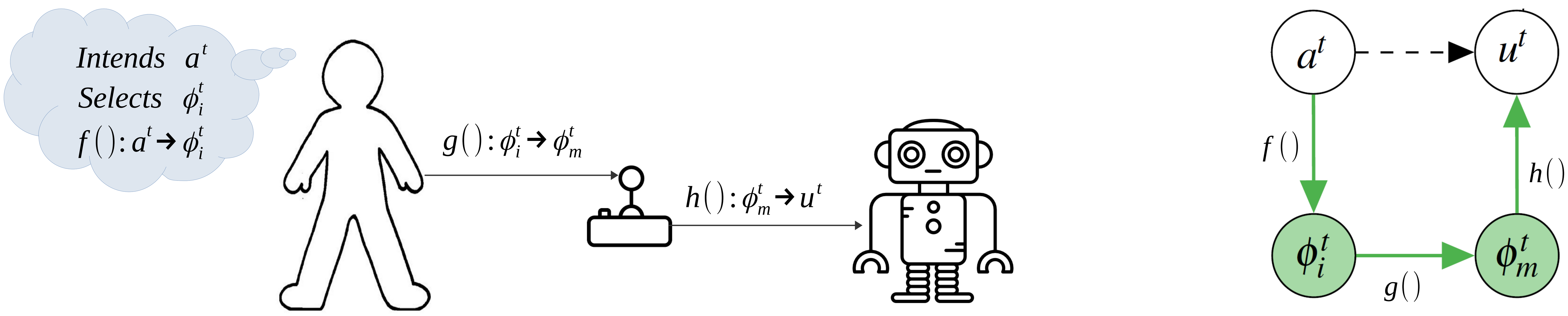

Figure 1: Illustration of interface mappings represented in our framework (*left*). Graphical model depiction of interface mappings (*right*). Under typical teleoperation (dashed line) these mappings are not modeled. (Though h(·) might be known.) a^t, u^t : robot task-space action and associated control command, ϕ^t_i, ϕ^t_m : intended versus measured interface activation.

We introduce a framework for *interface-awareness* in robot teleoperation and robotics autonomy.

- Novel robot intelligence paradigms: To complement characteristics of, or compensate for degradations in, control signals issued from a *known and characterized* combination of control interface and human operator.
- Experimental work within two salient, and distinct, fields: shared-autonomy between humans and robots, with a particular focus on assistive robotics, and learning from human demonstrations.

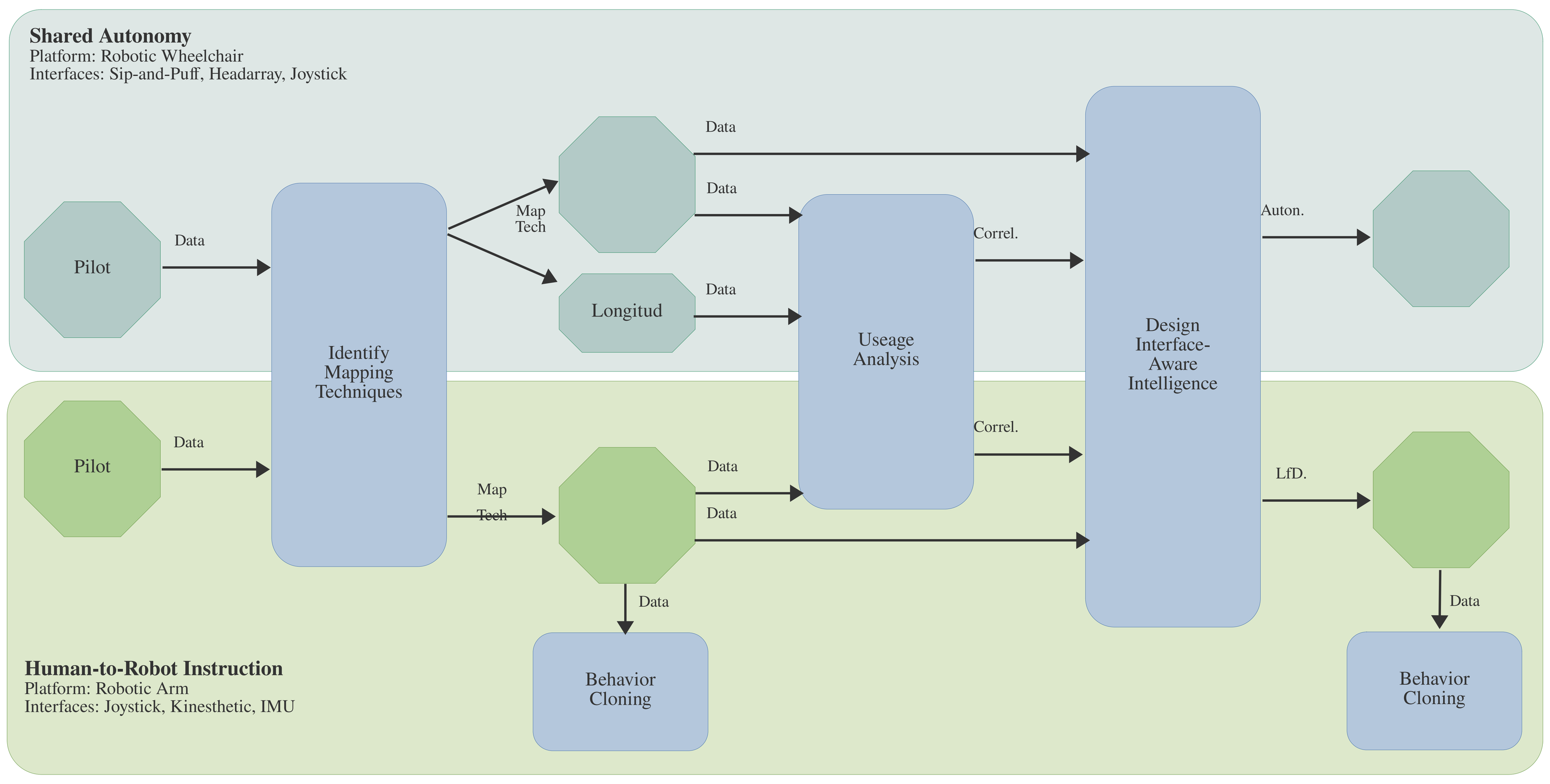

Figure 2: Application domain: human operators with motor impairments. Shared-control robotic wheelchair and control interfaces (2-axis joystick, switch-based head array, sip-and-puff), differ in *activation, dimensionality*, and *proportionality*.

Figure 3: Application domain: Robot learning from human instructors. Robotic arm and control interfaces (3-axis joystick, motion tracking via IMUs, kinesthetic operation), differ in *activation*, *dimensionality*, and *proportionality*.