

Instrumented Human Embodiment: A Transitional Substrate for Grounded Artificial General Intelligence

Abstract

Recent advances in artificial intelligence have been driven largely by large-scale language and multimodal models trained on static, human-generated data. While these systems demonstrate impressive task competence, they lack persistent memory, causal world models grounded in action, and robust uncertainty calibration. These limitations suggest that scaling data and parameters alone may be insufficient to achieve artificial general intelligence (AGI).

This paper proposes Instrumented Human Embodiment (IHE) as a transitional research substrate for grounded intelligence. IHE leverages a small cohort of highly trained, consent-based human participants equipped with minimal sensory instrumentation to provide structured access to real-world experience, including perception, action, hesitation, and uncertainty. Unlike surveillance-based data collection or fully autonomous robotics, IHE emphasizes intentionality, epistemic discipline, and ethical constraint.

We argue that IHE enables the acquisition of experiential knowledge that is inaccessible to language-only training while avoiding the technical, ethical, and governance risks of premature autonomy. We situate this approach within a capability-first definition of AGI, describe its compatibility with modular agent architectures, and outline a research agenda focused on uncertainty modeling, deferral behavior, and cross-domain generalization. Instrumented Human Embodiment reframes AGI development as a constrained, participatory process rather than a purely extractive or optimization-driven endeavor.

1. Introduction

Artificial intelligence research has entered a phase in which language-capable systems exhibit broad task coverage, conversational fluency, and limited reasoning ability across domains. Despite these achievements, such systems remain fundamentally dependent on static datasets derived from human-generated artifacts, primarily text, images, and curated video. This dependency imposes structural limitations: models trained in this manner lack grounded understanding of physical causality, social context, and the consequences of action, and they frequently exhibit overconfidence in situations of ambiguity.

The prevailing response to these limitations has been continued scaling—larger models, larger datasets, and increasingly sophisticated post-training alignment techniques. While effective in extending surface-level competence, this approach has shown diminishing returns with respect to generalization, robustness, and epistemic reliability. These observations suggest that the central challenge is not merely one of model capacity, but of experience.

Human intelligence develops through embodied interaction with the world: perception, action, feedback, and reflection under constraint. Language plays a critical role in abstraction and communication, but it is secondary to lived experience. By contrast, most contemporary AI systems encounter the world only indirectly, through symbolic traces left by others. This asymmetry raises a fundamental question for AGI research: How can artificial systems acquire the kinds of grounded experience necessary for general intelligence without incurring the risks associated with unrestricted autonomy or large-scale surveillance?

This paper proposes Instrumented Human Embodiment (IHE) as a transitional answer to this question. Rather than attempting to leap directly from language-trained models to fully autonomous embodied agents, IHE introduces a constrained intermediate layer in which disciplined human participants act as intentional, instrumented proxies within real-world environments. Equipped with limited sensory devices such as smart glasses and optional haptic interfaces, these participants generate episodic experiential data augmented by sparse cognitive annotations indicating hesitation, uncertainty, or expectation violation. Crucially, humans in this framework do not function as trainers, reward providers, or authorities. They provide experience, not instruction.

IHE is designed to satisfy several competing requirements simultaneously. It provides access to real-world perceptual and causal structure while avoiding mass data collection or covert observation. It supports modular, agent-based AI architectures that emphasize uncertainty modeling and restraint rather than optimization. It remains auditable, consent-based, and reversible, making it suitable for academic and ethical oversight. Most importantly, it shifts the focus of AGI research from performance maximization toward the acquisition of epistemic humility—knowing when information is insufficient, when action should be deferred, and when clarification is required.

The contribution of this paper is threefold. First, it reframes AGI as an intersection of capabilities—perception, action, memory, world modeling, and self-evaluation—rather than as a monolithic model or benchmark. Second, it introduces Instrumented Human Embodiment as a concrete, ethically defensible mechanism for acquiring grounded experience prior to autonomy. Third, it outlines a research agenda for evaluating this approach through constrained pilot studies focused on uncertainty calibration and cross-domain transfer, rather than claims of general intelligence.

AGI, if it emerges, is unlikely to appear as a single system or moment of achievement. It is more plausibly the result of a gradual process in which intelligence develops under constraint, shaped by interaction with the world and disciplined by the consequences of action. Instrumented Human Embodiment offers one such path—deliberate, limited, and grounded in lived reality.