Special Relativity Regime Compiler (SRRC)

A Reduced Instruction Set for Relativistic Invariants

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Abstract

Special Relativity specifies invariant structure but does not provide an operational mechanism for isolating that structure in a reduced, executable form. This paper introduces the *Semantic Special Relativity Compiler* (SSRC), a semantic kernel obtained by lifting Special Relativity into Semantic Regime Theory and descending to invariant operational primitives. Relativistic observational outcomes are quotiented by Lorentz equivalence, yielding a finite instruction set sufficient to express observer-independent meaning. The result is a compiler-oriented formulation of Special Relativity that preserves theory-level correctness while enabling reduced, compositional reasoning. This work establishes a bridge between relativistic semantics and executable systems without modifying physical laws.

Contents

1 Motivation and Scope

This paper introduces an operational artifact derived from Special Relativity through semantic descent. The goal is not reinterpretation of relativistic physics, but extraction of a reduced instruction set sufficient to capture relativistic invariants used in practice.

The compiler presented here is a semantic object: it executes meaning-preserving operations rather than numerical simulation.

1.1 Why a Compiler Metaphor Is Justified

2 Semantic Regimes in Special Relativity

Special Relativity implicitly defines semantic regimes via invariance under Lorentz transformation. Observational descriptions differing by admissible frame change correspond to the same semantic content.

Definition 2.1 (Relativistic Semantic Regime)**.** A relativistic semantic regime is an equivalence class of observational outcomes under Lorentz transformation preserving operational predictions.

Semantic regimes are quotient objects, not interpretive choices.

3 Equivalence Classes and Invariants

Definition 3.1 (Observational Equivalence)**.** Two observational outcomes are equivalent if they are related by a Lorentz transformation and yield identical invariant predictions.

Definition 3.2 (Semantic Invariant)**.** A semantic invariant is a quantity constant across an equivalence class of observational outcomes.

Lemma 3.3. *Only Lorentz-invariant quantities descend to regime-level semantic structure.*

Proof. Lorentz invariance is precisely the condition required for well-definedness on the quotient space of observational equivalence classes. □

4 Quotient Structure and Semantic Descent

5 The Semantic Relativity Kernel

The semantic kernel of Special Relativity consists of the minimal set of operations required to generate all regime-level invariants.

Definition 5.1 (Semantic Relativity Kernel)**.** The Semantic Relativity Kernel is the algebra generated by invariant-preserving operations under semantic descent.

This kernel forms the theoretical basis of the compiler.

5.1 Finiteness and Minimal Generating Sets

6 Opcode Set and Instruction Semantics

The compiler instruction set consists of a finite collection of semantic operations corresponding to invariant-preserving transformations.

Remark 6.1. Each opcode represents a semantic operation, not a numerical procedure.

Opcode semantics are defined entirely at the regime level.

6.1 Instructions as Semantic Roles

7 Compiler Architecture

The Semantic Special Relativity Compiler operates by mapping observational input to semantic regimes, executing invariant-preserving instructions, and emitting regime-consistent outputs.

Definition 7.1 (Semantic Compilation)**.** Semantic compilation is the process of mapping representational input to invariant operational structure.

The compiler architecture enforces semantic correctness by construction.

7.1 Semantic Completeness Without Execution

8 Semantic Descent and Operational Meaning

Semantic descent eliminates representational degrees of freedom while preserving meaning.

Theorem 8.1 (Operational Completeness)**.** *The Semantic Relativity Kernel is sufficient to express all observer-independent relativistic content.*

Proof. All observer-independent content corresponds to Lorentz invariants, which are generated by kernel operations. □

9 Universality and Factorization Property

10 Non-Goals and Scope Limits

This work makes no claims about implementation strategies, data structures, or instruction realizations.

11 Conclusion

Special Relativity admits a reduced, executable semantic form. By quotienting observational structure and descending to invariants, relativistic meaning becomes operational. The Semantic Special Relativity Compiler demonstrates that theory-level rigor and executable simplicity are not in conflict.

Meaning is not computed. It is preserved.

A Appendix: References

References

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