Neurophenomenological Simulator v2.0

Advanced Phenomenological Coefficients Theory

Marco Antonio Morelos Navidad
ORCID: 0009-0007-0083-5496
Estudiante Licenciatura Psicología Biomédica
Universidad Autónoma Metropolitana

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Executive Summary

The **Neurophenomenological Simulator v2.0** represents a major advancement in computational consciousness research, implementing a complete mathematical framework with rigorous scientific validation. This release introduces advanced validation mechanisms, mind-brain isomorphism analysis, and comprehensive experimental testing capabilities.

Key Innovations in v2.0

Advanced Scientific Validation

- **Isomorphism Analysis**: Implementation of Theorem 3 (Mind-Brain Isomorphism $\Phi : \mathcal{H} \to \mathcal{N}$)
- **Statistical Validation**: Pearson correlation, ROC analysis, hysteresis detection
- **Automated Reporting**: Comprehensive scientific validation reports

Enhanced Computational Framework

- **Dual Simulation Modes**: Basic research & advanced validation
- **Containerized Execution**: Docker support for full reproducibility
- **Robust Error Handling**: Professional-grade implementation

Complete Documentation

- Theoretical framework specification
- API references and usage examples
- Validation methodology documentation
- Installation and troubleshooting guides

Technical Specifications

Category	Specifications
Programming Language	Python 3.8+
Dependencies	NumPy, SciPy, Streamlit, Plotly, scikit-learn
Architecture	Modular, extensible design
Validation Methods	Statistical testing, ROC analysis, correlation
Reproducibility	Docker containers, version control, automated tests
License	MIT Open Source

Table 1: Technical specifications of the simulator

Quick Start Guide

Basic Installation

```
# Install required dependencies
pip install numpy matplotlib streamlit scipy plotly
    pandas scikit-learn

# Run the simulator
streamlit run main_actual.py
```

Access the Interface

- Open web browser to: `http://localhost:8501`
- Configure parameters in sidebar
- Select experimental paradigm
- Execute simulation

Experimental Paradigms

The simulator includes four experimental paradigms:

1. **validacion_gamma**: Gamma synchronization validation
2. **anestesia_general**: General anesthesia simulation
3. **microestimulacion**: Microstimulation effects analysis
4. **basal**: Baseline conscious state

Scientific Validation Framework

Validation Metrics

Validation Type	Expected Value	Threshold
Γ-—c— correlation	$r > 0.7$	Statistical
Threshold accuracy	$> 85\%$	Empirical
AUC in ROC analysis	> 0.9	Statistical
Hysteresis detection	Present	Qualitative

Table 2: Expected validation results

Statistical Methods

- **Pearson Correlation**: $\Gamma(t)$ vs $|c(t)|$ isomorphism
- **ROC Analysis**: Phenomenological threshold validation
- **T-tests**: Conscious vs unconscious state differences
- **Regression Analysis**: Coefficient relationships

Access and Citation

Software Access

- **Primary DOI**: https://doi.org/10.5281/zenodo.17689427
- **Theoretical Framework**: https://doi.org/10.5281/zenodo.17596542
- **All Versions**: https://doi.org/10.5281/zenodo.17619906

Recommended Citation

```
@software{morelos_navidad_2024_17689427,
        author       = {Marco Antonio Morelos Navidad},
        title        = {Neurophenomenological Simulator
           v2.0: Advanced
                Phenomenological Coefficients Theory},
        year         = 2024,
        publisher    = {Zenodo},
        doi          = {10.5281/zenodo.17689427},
        url          = {https://doi.org/10.5281/zenodo
           .17689427}
}
```

Research Applications

Primary Research Areas

- Computational neuroscience research
- Consciousness studies and modeling
- Neural correlates of consciousness
- Theoretical neuroscience development

Educational Uses

- Teaching computational neuroscience
- Consciousness theory courses
- Research methodology training
- Open science practices

System Requirements

Minimum Requirements

- Python 3.8 or higher
- 4GB RAM
- Modern web browser
- 500MB disk space

Recommended Specifications

- 8GB RAM for large simulations
- Multi-core processor
- Stable internet connection
- GPU acceleration (optional)

Support and Documentation

Available Resources

- **Complete Documentation**: In-package comprehensive guides
- **Usage Examples**: Basic to advanced workflows
- **API Reference**: Detailed class and method documentation
- **Validation Methods**: Scientific validation protocols

Community Support

- ResearchGate project page
- GitHub repository issues
- Academic collaboration opportunities
- Email contact for technical support

Theoretical Framework

Mathematical Foundations

The simulator implements the complete Phenomenological Coefficients Theory:

- **Axiom 1**: Conscious state space $\mathcal{H}$ with orthonormal basis
- **Axiom 2**: Phenomenological coefficients $c_i(t) = \Gamma_i(t) \cdot A_i(t) \cdot e^{i\theta_i(t)}$
- **Theorem 1**: Unified conscious field $|\Psi(t)\rangle = \sum c_i(t)|\psi_i\rangle$
- **Theorem 2**: Resource conservation $\langle\Psi|\Psi\rangle \leq C_{\max}$
- **Theorem 3**: Mind-brain isomorphism $\Phi : \mathcal{H} \to \mathcal{N}$

License and Availability

Open Source Commitment

- **License**: MIT Open Source
- **Access**: No restrictions
- **Modification**: Allowed with attribution
- **Distribution**: Free redistribution

Long-term Preservation

- Permanent Zenodo archival
- Version-controlled releases
- DOI persistence
- Community maintenance

This software represents a significant advancement in computational consciousness research with rigorous scientific validation methodologies.

Contact: Marco Antonio Morelos Navidad
ORCID: 0009-0007-0083-5496
Email: 2173084147@correo.ler.uam.mx