Practical measures of integrated information

Measure	Description	Reference
Φ	Information lost after splitting the system	[12]
$\tilde{\Phi}$	Uncertainty gained after splitting the system	[2]
ψ	Synergistic predictive information between parts of the system	[3]
Φ^*	Past state decoding accuracy lost after splitting the system	[5]
Φ_G	Information-geometric distance to system with disconnected parts	[4]
CD	Average pairwise directed information flow	[13]

	Φ	$\tilde{\Phi}$	ψ	Φ^*	Φ_G	CD
Time-symmetric	✓	✓	✗	?	✓	✗
Non-negative	✗	✓	✓	✓	✓	✓
Invariant to variable rescaling	✓	✗	✓	✓	✓	✓
Upper-bounded by time-delayed mutual information	✓	✗	✓	✓	✓	✓
Known estimators for arbitrary real-valued systems	✓	✓	✗	✗	✗	✓
Closed-form expression in discrete and Gaussian systems	✓	✓	✓	✗	✗	✓

Mediano et al., 2019. Measuring Integrated Information: Comparison of Candidate Measures in Theory and Simulation.

IIT: Further reading

Lee et al., 2008. Propofol induction reduces the capacity for neural information integration: Implications for the mechanism of consciousness and general anesthesia.
    φ; anaesthetized human; EEG

Kim et al., 2018. Estimating the Integrated Information Measure Phi from High-Density Electroencephalography during States of Consciousness in Humans.
    $\tilde{\varphi}$; anaesthetized human; EEG

Kim and Lee, 2019. Criticality as a Determinant of Integrated Information Φ in Human Brain Networks.
    $\tilde{\varphi}$; anaesthetized human; EEG

Luppi et al., 2021. A synergistic workspace for human consciousness revealed by integrated information decomposition.
    φ_R; anaesthetized human; fMRI

Afrasiabi et al., 2021. Consciousness depends on integration between parietal cortex, striatum and thalamus.
    φ^*; sleeping, anaesthetized macaque; implanted electrode

Melloni et al., 2023. An adversarial collaboration protocol for testing contrasting predictions of global neuronal workspace and integrated information theory.

Fleming et al., 2023. The Integrated Information Theory of Consciousness as Pseudoscience.