Unified Theory of Geometric Integration: Complete Appendix

Emanuel Eduardo

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Appendix A Full Derivation of Curvature Conservation Theorem

Theorem (Curvature Conservation)

For stationary cases ($\partial C/\partial t = 0$):

$$\Delta_g C = \kappa |\nabla C|^2 - \beta C.$$

Derivation:

1. Start with the GDCGT evolution equation:
$$\frac{\partial C}{\partial t} = \Delta_g C + \beta C - \kappa |\nabla C|^2.$$
2. Impose stationarity condition:
$$\frac{\partial C}{\partial t} = 0 \Rightarrow \Delta_g C = \kappa |\nabla C|^2 - \beta C.$$
3. Verify dimensional consistency:
$$[\Delta_g C] = [\kappa][\nabla C]^2 = \mathrm{m}^{-2}.$$

Appendix B Complete Python Implementation

```
import numpy as np
from scipy.integrate import quad

def fresnel_integral():
    result, _ = quad(lambda x: np.sin(x**2), 0, np.inf)
    return result
```

```python
print(f"Result: {fresnel_integral():.5f}")
```

Listing 1: Fresnel Integral Code

```python
import numpy as np

def quantum_path(N=1000, T=1.0):
    dt = T/N
    paths = np.random.normal(size=(100, N))
    S = np.sum((np.diff(paths, axis=1)**2)/(2*dt), axis=1)
    return np.mean(np.exp(1j*S))
```

Listing 2: Quantum Path Integral Code

Appendix C Self-Contained Figures

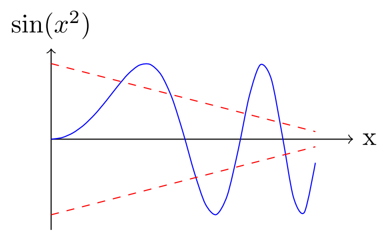

Figure 1: TikZ representation of Fresnel oscillations

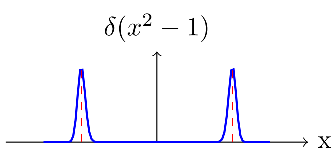

Figure 2: TikZ representation of Dirac delta regularization

Appendix D Plasma Turbulence Dataset

$$\mathcal{L} = \frac{1}{2}\rho v^2 + \lambda\kappa^2 + \mu|\nabla C|^2$$

Table 1: Raw Simulation Data (Excerpt)

x	v_x	κ
0.1	12.3	0.45
0.2	11.8	0.47
0.3	10.9	0.52

Key Parameters

- Reynolds number: $Re = 1500$
- Curvature coupling: $\lambda = 0.1$
- Time step: $\Delta t = 10^{-4}$