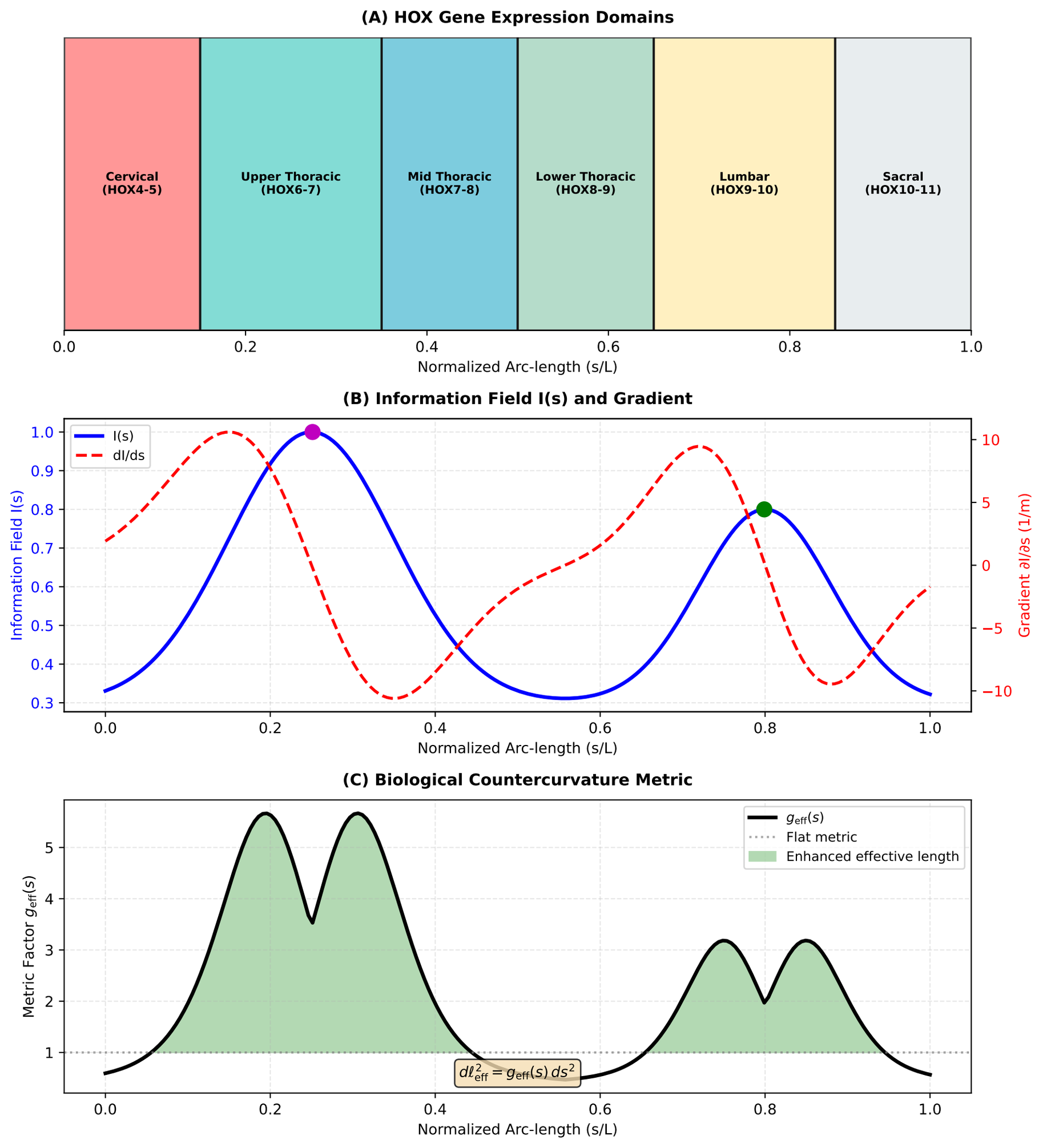
(A) HOX Gene Expression Domains
Cervical (HOX4-5)
Upper Thoracic (HOX6-7)
Mid Thoracic (HOX7-8)
Lower Thoracic (HOX8-9)
Lumbar (HOX9-10)
Sacral (HOX10-11)
0.0
0.2
0.4
0.6
0.8
1.0
Normalized Arc-length (s/L)
(B) Information Field I(s) and Gradient
I(s)
dI/ds
Information Field I(s)
Gradient ∂I/∂s (1/m)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
10
5
0
−5
−10
0.0
0.2
0.4
0.6
0.8
1.0
Normalized Arc-length (s/L)
(C) Biological Countercurvature Metric
$g_{\text{eff}}(s)$
Flat metric
Enhanced effective length
Metric Factor $g_{\text{eff}}(s)$
5
4
3
2
1
$d\ell_{\text{eff}}^2 = g_{\text{eff}}(s)\, ds^2$
0.0
0.2
0.4
0.6
0.8
1.0
Normalized Arc-length (s/L)