UTM - DIRECT Map Projections (Snyder)

0.1 Notations and Definitions (as per USGS Professional Paper 1395)

0.1.1 Required Input:

φ	Latitude of point (positive north) Comment (B) Note: Angles in radians
λ	Longitude of point (positive east) Comment (L) Note: Western longs negative
ω	Rectifying latitude
φ_0	Latitude of grid origin Comment (Bs) Note: Northern lats positive
λ_0	Longitude of Central Meridian (=Grid Origin) Comment (Lo)
E_f	False Easting of the Grid Origin Comment for everywhere = 500,000 [m]
N_f	False Northing of the Grid Origin Comment for north lats=0, for south lats=10,000,000[m]
S	Meridional distance to point (on ellipsoid)[m]
S_0	Meridional distance along CM on projection plane, from equator to φ_o Comment [m]
k_0	Grid scale factor assigned to the CM (sets secant depth, =09996 always)
k	Grid scale factor at the point
a	Ellipsoid semi-major axis Comment [m]
f	Flattening of the ellipsoid
Z	Desired projection zone ID Comment Note: Used as look-up index

0.1.2 Intermediate calculated values

e^2 First eccentricity of the ellipsoid

e'^2 Second eccentricity of the ellipsoid

0.1.3 Desired Output

N Northing of point Comment [m]

E Easting of point Comment [m]

γ Convergency angle at point Comment (C)

0.2 Calculate Zone Constants

$e^2 = \sqrt{2f - f^2}$)

$e'^2 = e^2/(1-e^2)$

Z = (enter zone #, 1-60)

φ_0 = 0 (for northern lats = 0, for southern = 10,000,000)

λ_0 = 6Z-183 (longitude of central meridian)

k_0 = 0.9996 (from 1/2,500)

0.3 Calculate Direct Coversion Computation

$m1 = (1 - e^2/4 - 3e^4/64 - 5e^6/256)\varphi$

$m2 = -(3e^2/8 + 3e^4/32 + 45e^6/1024)\sin(2\varphi)$

$m3 = (15e^4/256 + 45e^6/1024)\sin(4\varphi)$

$m4 = -(35e^6/3072)\sin(6\varphi)$

$M = a(m1 + m2 + m3 + m4)$

$m1o = (1 - e^2/4 - 3e^4/64 - 5e^6/256)\varphi_0$

$m2o = -(3e^2/8 + 3e^4/32 + 45e^6/1024)\sin(2\varphi_0)$

$m3o = (15e^4/256 + 45e^6/1024)\sin(4\varphi_0)$

$m4o = -(35e^6/3072)\sin(6\varphi_0)$

$Mo = a(m1 + m2 + m3 + m4)$ Comment Mo = 0 for all UTM, because Phio = 0)

$W = \sqrt{1 - e^2 \sin^2(\varphi)}$

$N = a/W$

$T = \tan^2(\varphi)$

$C = e'^2 \cos^2(\varphi)$

$A = (\lambda - \lambda_o)\cos(\varphi)$ Comment For western longs, λ has to be negative

$m5 = M - Mo + N\tan(\varphi)(A^2/2 + (5 - T + 9C + 4C^2)A^4/24 + (61 - 58T + T^2 + 600C - 330e'^2)A^6/720)$

$m6 = A + (1 - T + C)A^3/6 + (5 - 18T + T^2 + 72C - 58e'^2)A^5/120$

$m7 = 1 + (1 + C)A^2/2 + (5 - 4T + 42C + 13C^2 - 28*e'^2)A^4/24 + (61 - 148T + 16T^2)A^6/720$

$Northing = Nf + k_0 m5$

$Easting = Ef + k_0 Nm6$

$k = k_0 * m7$

$\gamma = (\lambda - \lambda_o)\sin(\varphi)$