

Motion Coordinates

Mechanical Engineering

Three ways to write velocity and acceleration, and when each is easiest.

Pick the system the path suggests, not the one you know best.

System	Use when	Acceleration
Cartesian	Path given as $x(t)$, $y(t)$	Second derivatives of x , y
Normal-tangential	Speed along a known curve	dv/dt along, $v^2 \div \rho$ inward
Polar, r and θ	Motion about a fixed centre	Radial, plus a Coriolis term
Rotating frame	Linkages and machinery	Adds $\omega \times (\omega \times r)$ and $2\omega \times v$

Normal-tangential splits speeding up from turning. The $v^2 \div \rho$ part never vanishes on a curve.