

Diffusivity (D)

Definition: 'Diffusivity' (symbol: 'D') refers to the rate at which molecules (typically water in MRI) spread out over space due to random Brownian motion. It is measured in units of mm^2/s .

In brain imaging, diffusivity quantifies the movement of water molecules within tissue microstructure, providing insight into:

- [cellularity](#)
- [extracellular space](#)
- [tissue anisotropy](#)
- [edema](#) and [inflammation](#)

Types of Diffusivity in MRI:

- 'Apparent Diffusion Coefficient (ADC):' A scalar value representing the average water diffusion in a voxel.
- 'Axial Diffusivity (AD):' Diffusion along the principal axis of white matter tracts.
- 'Radial Diffusivity (RD):' Diffusion perpendicular to the principal axis.
- 'Mean Diffusivity (MD):' Average of diffusivity along all directions.
- 'Interstitial Fluid Diffusivity (D_{int}):' Estimated using advanced techniques like spectral diffusion MRI; reflects fluid mobility in extracellular (interstitial) space.

Clinical Relevance:

- ↓ **Diffusivity** → may indicate cytotoxic edema (e.g., in acute stroke).
- ↑ **Diffusivity** → may reflect increased extracellular space (e.g., neurodegeneration, vasogenic edema, INPH).
- Alterations in D_{int} may correlate with changes in interstitial fluid dynamics and glymphatic dysfunction.

Measurement Techniques:

- [Diffusion-weighted imaging \(DWI\)](#)
- [Diffusion tensor imaging \(DTI\)](#)
- [Spectral diffusion analysis](#) (for compartment-specific diffusivity like D_{int})

See also:

- [F_{int} — Interstitial fluid volume fraction](#)
- [Diffusion MRI](#)
- [Glymphatic system](#)
- [Isotropic vs. anisotropic diffusion](#)

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