TECHNIQUES TO ADD TO YOUR LIST

A. Magnetic / MRI-Related (Non-Invasive)

1. Functional Connectivity MRI (fcMRI)

Not the same as BOLD; uses correlation structure across voxels.
(Probably implicit, but useful to explicitly list.)

2. Resting-State fMRI (rs-fMRI)

Now its own category of technique with unique analytical methodology.

3. Magnetic Particle Imaging (MPI)

A new imaging modality using superparamagnetic nanoparticles for high temporal resolution neurovascular imaging.

4. Susceptibility-Weighted Imaging (SWI)

Useful for venous blood mapping and hemodynamic activity in vivo.

5. Quantitative Susceptibility Mapping (QSM)

Reconstructs iron content and hemodynamic changes related to function.

6. Functional MRS (fMRS)

Measures neurotransmitter fluctuations (Glu, GABA) in vivo in real time.

7. Magnetic Resonance Elastography (MRE)

Measures brain tissue stiffness changes associated with neural activity and neurovascular coupling.

8. Chemical Exchange Saturation Transfer (CEST) fMRI

Detects metabolites and neurotransmitters via exchangeable protons, providing molecular functional imaging.

B. PET / Radiotracer Advances

7. Fiber-Coupled PET Detectors (minimally invasive)

Enables localized in vivo PET from freely moving animals.

8. Neuroimmune PET Ligands (TSPO, CSF1R etc.)

For studying microglial/astrocyte activation dynamically.
(Not purely activity, but increasingly part of functional neuroimaging.)

9. Total-Body PET Imaging

Enables whole-brain dynamic imaging with unprecedented temporal resolution and sensitivity.

10. Positronium Lifetime Imaging

Emerging PET technique providing information about tissue microenvironment during neural activity.

C. Electrophysiology & Implant Technologies

9. Neuropixels Probes (latest gen)

Not just "multielectrode"; Neuropixels constitute a distinct class due to ultra-high channel count (1,000+), used in vivo widely.

10. Silicon Probe Laminar Recordings

For cortical column laminar activity (V1, CA1).

11. High-Density "ECoG Grids" (Neuropixels-ECoG hybrids)

New grids with thousands of micro-electrodes recordings across cortex.

12. EMG-assisted Brain-Body Coupled Recording

Used in behaving animals to integrate motor output with neural activity.

13. Flexible Bioelectronic Neural Interfaces

Conformable electrode arrays that minimize tissue damage and enable stable long-term recordings.

14. Transparent Graphene Microelectrode Arrays

Allow simultaneous electrical recording and optical imaging/optogenetics.

15. Ultrasonic Neural Dust Motes

Wireless, millimeter-scale implants for chronic neural recording.

D. Optical / Imaging-Based Techniques

13. Light-Sheet Fluorescence Microscopy (LSFM) In Vivo

Now used in small transparent animals (zebrafish, larval models).
Technically in vivo and provides whole-brain fast activity imaging.

14. Swept Confocally-Aligned Planar Excitation (SCAPE) Microscopy

High-speed volumetric neural imaging in freely moving animals.

15. Structured-Light 3D Imaging of Cortical Hemodynamics

Used to map neural activity via intrinsic signals & hemodynamic changes.

16. Mesoscopic Calcium Imaging (NOT miniscope)

Widefield mesoscopic Ca^{2+} imaging in vivo (distinct from fiber photometry).

17. Adaptive Optics for In Vivo Neural Imaging

Corrects deep-tissue optical distortion; rapidly emerging technique.

18. Oblique Plane Microscopy (OPM)

High-resolution, high-speed volumetric imaging for large-scale neural activity monitoring.

19. Multifocal Two-Photon Microscopy

Simultaneous imaging of multiple planes for 3D functional imaging.

20. Line-Scanning Temporal Focusing Microscopy

High-speed volumetric imaging with reduced out-of-focus excitation.

E. Optical Indicators / Novel Sensors

18. Genetically Encoded Dopamine Indicators (GRAB-DA, dLight1)

You have neurotransmitter sensors, but these widely used in vivo tools (fiber photometry, 2p microscopy) deserve a separate explicit item.

19. Genetically Encoded Glutamate Indicators (IGluSnFR)

High temporal resolution; used to study excitatory transmission.

20. Genetically Encoded Acetylcholine Indicators (GACH)

Maps cholinergic dynamics in vivo.

21. Genetically Encoded cAMP / PKA / Second-Messenger Sensors

(e.g., Pink Flamindo, G-Flamp).
Reflect intracellular signaling during neural activity.

22. Genetically Encoded Serotonin Sensors (GRAB5-HT)

Monitor serotonergic transmission in behaving animals.

23. Genetically Encoded Norepinephrine Sensors (GRAB-NE)

Track noradrenergic activity during behavior and cognitive tasks.

24. Fluorescent False Neurotransmitters (FFNs)

Visualize neurotransmitter release and recycling in vivo.

25. Genetically Encoded Chloride Indicators (Cl-Sensor)

Monitor chloride dynamics relevant for inhibitory transmission.

F. Photoacoustic & Hybrid Techniques (outside your list)

22. Voltage-Sensitive Photoacoustic Imaging

A new area combining voltage dyes with photoacoustics.

23. Nanodiamond Magnetometry in Vivo

Nitrogen-vacancy (NV) diamond sensors used for in vivo magnetic field measurements of neuronal activity.

24. Multispectral Optoacoustic Tomography (MSOT)

Provides spectral unmixing of multiple chromophores for functional brain imaging.

25. Photoacoustic Computed Tomography (PACT)

Deep-tissue functional imaging with optical contrast and ultrasound resolution.

G. Neural Activity Through Blood Flow & Oxygenation

24. Thermal Infrared Functional Imaging (fTIRI)

Detects activity-induced microvascular heating.

25. Speckle-Modulated Optical Coherence Tomography (OCT)

OCT-based neuronal activity mapping (beyond your "laser speckle imaging").

26. Doppler Optical Coherence Tomography (D-OCT)

For real-time blood-flow-linked neural activity measurements.

27. Visible Light Optical Coherence Tomography (vis-OCT)

Provides oximetry and flow measurements with higher resolution than NIR-OCT.

28. Hyperspectral Imaging of Intrinsic Signals

Spectral unmixing of hemoglobin, cytochrome oxidase, and other chromophores.

H. Behavioral + Neural Integrated Techniques

27. Neuromorphic Cameras Linked With Neural Imaging

High-speed event-driven sensors capturing animal behavior synchronized with brain activity (not a brain technique per se, but part of modern in vivo pipelines).

28. Deep-Label-Free Microscopy (DLFM)

Uses deep learning to extract neural activity from label-free imaging of scattering changes.

29. Acoustic Recording of Neural-Related Behavior

Ultrasonic vocalization recording synchronized with neural activity measurements.

I. Interference / Modulation Techniques to Add

28. Focused Ultrasound Blood–Brain Barrier Opening (FUS-BBBO)

Used in vivo to modulate circuits or allow entry of neuromodulators.

29. Temporal Interference Stimulation (TI Stimulation)

Non-invasive deep brain electromagnetic stimulation using intersecting high-frequency currents.

30. Transcranial Random Noise Stimulation (tRNS)

Another electrical non-invasive modulation technique widely used.

31. Photothermal Neuromodulation (non-genetic)

Uses nanoparticles or infrared light to activate neurons.

32. Infrared Neural Stimulation (INS)

Pulsed IR light drives neural activity—distinct from optogenetics.

33. Scanning Ultrasound Neuromodulation (SUN)

Focused ultrasound for precise spatial-temporal neural control.

34. Optoacoustic Neuromodulation

Uses laser-generated ultrasound for deep-brain stimulation.

35. Ion-CeMST (Ion Current-Controlled Microfluidic Stimulation)

Microfluidic-based chemical stimulation with spatiotemporal precision.

J. Emerging & Frontier Approaches

33. Bioluminescent Voltage Imaging (e.g., LOTUS-V)

No excitation light; extremely low phototoxicity for in vivo activity imaging.

34. Upconversion Nanoparticle-Based Neural Imaging

Allows deeper brain optical readout using NIR-to-visible conversion.

35. Magnetothermal Neural Recording & Readout

Not just thermogenetics stimulation—actual readout emerging via nanomaterials.

36. Molecular fMRI (m-fMRI)

Probes coupling specific cellular signaling events to MRI contrast.

37. Functional Ultrasound Localization Microscopy (ULM-fUS)

Super-resolution vascular mapping during activity.

38. "Neuromodulation via Magnetic Nanodiscs"

A newer mechanogenetic-like frontier method.

39. Quantum Diamond Microscopy

Uses NV centers for magnetic imaging of neural activity at nanoscale.

40. X-ray-Induced Acoustic Computed Tomography (XACT)

Combines X-ray absorption with ultrasound detection for functional imaging.

41. Magnetic Resonance Spectroscopic Imaging (MRSI)

Spatially resolved spectroscopy for mapping neurotransmitter distributions.

42. Neutron Stimulated Emission Computed Tomography (NSECT)

Emerging nuclear technique for elemental mapping of neural tissue.