

# **Survey of ModelDB entries that were published from 2013-present**

## ***Subcellular mechanisms***

### **Synaptic transmission**

Mechanism of transmitter release: 182142 (Keller et al. 2015)

Functional consequences of synaptically-induced conductance changes: 152539 (Cavallari et al. 2014)

Focal inhibition of excitatory input onto individual spines: 143604 (Chiu et al. 2013)

Plasticity: interaction of multiple forms of short term synaptic plasticity 152200 (Zhou et al. 2014), effect of initial synaptic state on induction of LTP and LTD 157339 (Migliore et al. 2015), dopamine-dependent plasticity at corticostriatal synapses 151458 (Nakano et al. 2013), Gq coupled signaling pathways involved in striatal synaptic plasticity 154967 (Kim et al. 2013), effect of calcium waves on mGluR-dependent synaptic plasticity 150551 (Ashhad and Narayanan 2013)

### **Roles of intra- and extracellular ionic concentrations in neuronal function**

Calcium waves: 168874 (Neymotin et al. 2015), 150551 (Ashhad and Narayanan 2013)

Other calcium fluctuations: calcium influx during striatal upstates (Evans et al. 2013)

Effects of Na and K concentration changes on cellular dynamics: 167714 (Hubel and Dahlem, 2014), 169023 (Krishnan et al. 2015)

### **Regulation of extra- and intracellular milieu**

Astrocytic regulation of extracellular ionic concentrations: 151945 (Halnes et al. 2013)

Intracellular movement of proteins: electroosmosis 147740 (Andreev 2013), microtubular transport of kinases 153740 (Koon et al. 2014)

## ***Cellular properties and phenomena***

### **Cellular morphology (also see *Synthesis of model neurons and networks*)**

Mechanisms that govern development of individual neurons: 152788 (Hjorth et al. 2014)

Effects of morphology on function: dendritic excitability 146509 (Ferrante et al., 2013), synaptic integration 156828 (Simoes\_De\_Souza et al. 2014), calcium dynamics 155731 (Anwar et al. 2014)

### **Physiology of particular cell classes**

Information processing in individual neurons: cerebellar granule cells 156733 (Rossert et al. 2014)

Excitability: motoneurons 180370 (Balbi et al. 2015), dorsal reticular nucleus neurons (Sousa et al., 2014), myenteric sensory neurons 155796 (Chambers et al. 2014)

### **Factors that affect cellular excitability and spontaneous activity**

Potassium channels: pituitary lacto-somatotroph cells 154955 (Vo et al. 2014), excitability of dentate granule cells 169240 (Mateos-Aparicio et al., 2014)

Experience-driven modulation of intrinsic excitability: 155131 (Scheler 2014)

Hormonal modulation of neuronal excitability: angiotensin II 156830 (Makadia, Anderson, Fey et al., 2015)

Effects of dendritic geometry and ion channel distributions on cellular activity and synaptic integration: 149000 (Marasco et al, 2013)

Transition from continuous to saltatory conduction in myelinated axons (Lillie transition): 169208 (Young et al. 2013)

### **Dendritic excitability**

Effect of dendritic structure on spike initiation and propagation: branch point morphology 146509 (Ferrante et al., 2013)

Ionic mechanisms: 151825 (Almog and Korngreen 2014)

Variability of dendritic calcium spikes: 150635 (Anwar et al. 2013)

Local dendritic spikes: spatially localized synaptic integration 167694 (Behabadi and Mel 2014)

Roles of dendritic excitability: in sensory integration 180373 (Shai et al., 2015), persistent activity and working memory 155057 (Papoutsi et al. 2013, 2014), and function of cortical microcircuits 156780 (Hay and Segev 2014)

### **Networks and systems**

Roles of particular ion channels in network function: 153355 (Lamb & Calabrese 2013)

### **Plasticity and network development, function, and maintenance**

"Learning" network architecture by activity combined with plasticity: connectivity motifs from interaction of network activity with short- and long-term synaptic plasticity 150211 (Vasilaki, Giugliano 2014), retinotopic maps 183251 (Hjorth et al. 2015), orientation maps 151951 (Stevens et al. 2013), neocortex 147141 (Rowan and Neymotin 2013), cortical color opponent receptive fields 152197 (Eguchi et al., 2014), balanced networks 182784 (Sadeh et al. 2015), visual system changes induced by visual deprivation 180791 (Toyoizumi et al. 2014), olfactory bulb circuitry 144570 (Yu et al. 2013) and 151681 (Migliore et al. 2014), self-organized olfactory pattern recognition 155157 (Kaplan and Lansner 2014), auditory circuitry for detecting sliding pitch 168407 (Skorheim et al. 2014), emergence of grid cell firing from intrinsic conductances plus synaptic input to medial entorhinal stellate cells 150239 (Schmidt-Hieber & Hausser 2013), grid cells from place cells 150846 (Castro and Aguiar, 2014), emergence of sparse coding in V1 182373 (King et al. 2013)

Network homeostasis: mediated by adjustment of neural excitability through diffusion of nitric oxide 183371 (Sweeney et al. 2015), functional consequences of contrast-gain control and homeostatic plasticity 151951 (Stevens et al. 2013)

Network stabilization by short term synaptic depression: 168314 (Hummos et al. 2014)

Functional consequences of multiple distributed mechanisms for synaptic plasticity: adaptive gain control 149913 (Garrido et al., 2013), fast convergence of cerebellar learning 150225 (Luque et al. 2015)

Subcellular mechanisms of network plasticity embedded in network architecture: endocannabinoids and Gq-coupled signaling in striatum 154967 (Kim et al. 2013)

### **Inhibition in networks**

Role of parvalbumin-positive basket cells in hippocampus 153280 (Lee et al. 2014)

Roles of different interneuron classes in persistent activity 168310 (Konstantoudaki et al. 2014)

Stabilization of Ca3 region of hippocampus: 168314 (Hummos et al. 2014)

Control of L5 pyramidal cell spiking: by oscillatory inhibition in distal apical dendrites 150538 (Li et al. 2013)

Role of lateral inhibition in emergence of functional network architecture (Yu et al. 2013)

## ***Sensory processing***

### **Olfaction**

Peripheral receptors: transduction and adaptation in olfactory cilium 151686 (Antunes et al. 2014)

Network models of olfactory system: odor coding by microcircuits 153574 (Gilra and Bhalla 2015), olfactory bulb circuits for determination of odor identity and intensity 168418 (Polese et al. 2014), response to time-varying odor stimuli in juxtaglomerular models 15211 (Carey et al., 2015), self-organization of pattern recognition in model of olfactory bulb plus pyriform cortex 155157 (Kaplan and Lansner 2014), experience-driven formation of network architecture in a large scale 3D model of olfactory bulb 151681 (Migliore et al. 2014), role of polysynaptic facilitation in olfactory processing in a pyriform cortex - hippocampus model 181032 (Trieu et al. 2015)

Modulation of olfactory processing: adenosine effects in a pyriform cortex - hippocampus model 181032 (Trieu et al. 2015), cholinergic neuromodulation of olfactory processing in olfactory bulb 149739 (Li and Cleland 2013), cholinergic modulation of odor learning in olfactory bulb and piriform cortex 146813 (de Almeida et al. 2013; Devore S, et al. 2014)

### **Vision**

Roles of specific cell classes in visual processing: fly vertical system tangential cells and sensory coding 155727 (Trousdale et al. 2014), excitable dendrites and bursting in layer 5 pyramidal neurons in coincidence detection 180373 (Shai et al., 2015), consequences of inhomogeneous T current distributions for dendritic signaling and localized synaptic integration in LGN interneurons 156039 (Allken et al. 2014), role of inhibitory interneurons in coding in V1 182373 (King et al. 2013)

Network models: control of signal transfer from thalamus to cortex by corticothalamic modulation of resonance in thalamic relay neurons 150240 (Behuret et al. 2013), relative contributions of cellular properties and network architecture to orientation selectivity 182759 (Sadeh and Rotter, 2015), self-organization of cortical color opponent receptive fields 152197 (Eguchi et al., 2014), motion detection by a feedforward network in V1-MT 181035 (Solari et al., 2015)

### **Hearing**

Initial stages of auditory processing: functional model of inner ear microcircuitry 169278 (Zilany et al. 2009, 2014; Holmberg M 2007)

Auditory processing in the brainstem: local field potential generation in the medial superior olive 152112 (Goldwyn et al. 2014)

Cortical processing: generation of cortical waves in layer 4 of auditory cortex 150678 (Beeman 2013)

Pattern recognition: network models for detecting sliding pitch 168407 (Skorheim et al. 2014)

### **Electrosensation**

Specific cell classes involved in electrosensation: auditory processing in midbrain torus semicircularis neurons 183077 (Aumentado-Armstrong et al. 2015), coding by ELL pyramidal neurons 168590 (Simmonds and Chacron 2014)

### **Spatial sense**

Spatial perception and learning: emergence of grid cell firing from intrinsic conductances plus synaptic input to medial entorhinal stellate cells 150239 (Schmidt-Hieber & Hausser 2013), experience-induced development grid cells from place cells 150846 (Castro and Aguiar, 2014)

Mechanisms of independent gamma oscillations and grid firing 183017 (Solanka et al. 2015)

Theta-nested gamma oscillations (cross-frequency coupling of theta and gamma) in a network model of grid cells 150031 (Pastoll et al., 2013)

## **Pain**

Excitability of dorsal reticular nucleus neurons: 151949 (Sousa et al., 2014)

## ***Motor system***

Kv1 regulation of cerebellar output to thalamus: 150024 (Ovsepian et al. 2013)

Structural vs. functional architecture of motor cortex: microcircuit simulation based on brain activity mapping 146949 (Chadderdon et al. 2014)

## **Sensorimotor integration**

Reflex behavior: modulation of gill withdrawal reflex in Aplysia by interaction of multiple forms of short term synaptic plasticity 152200 (Zhou et al. 2014), gain adaptation of optokinetic reflex 180823 (Yamazaki et al. 2015), adaptation of the vestibulo-ocular reflex 167875 (Clopath et al. 2014)

Saccades: cells and circuitry in the intermediate superior colliculus underlying saccade generation 168866 (Moren et al. 2013)

Control of a robot: adaptive control by a cerebellar network model: 167414 (Casellato et al. 2014)

Posture and locomotion: crayfish 150697 (Chung et al. 2014) and 150698 (Bacque-Cazenave et al. 2014), modulation of reticulospinal neurons involved in lamprey swimming 151338 (Kozlov et al. 2014), human upright stance 180372 (Elias et al. 2014)

## ***Brain rhythms***

Central pattern generators: coupled oscillators in stomatogastric ganglion 149910 (Gutierrez et al. 2013), mechanisms for robustness in the face of temperature variation 152636 (Caplan JS et al., 2014), molecular network model of circadian clock in suprachiasmatic nucleus neurons 148320 (Kim and Forger 2013), generation of respiratory rhythms 181962 (Toporikova et al. 2015)

Cortical oscillations: roles of gap junctions and cellular subthreshold resonance 168599 (Tchumatchenko and Clopath 2014), interactions of cortical rhythms 155705 (Avella OJ et al. 2014), interlaminar interactions and delta-nested theta 150806 (Carracedo et al. 2013)

Functional roles of theta: mechanism of long intracortical delays in entorhinal-hippocampal network 181967 (Cutsuridis and Poirazi 2015), grid cells and theta-nested gamma oscillations 150031 (Pastoll et al., 2013)

Role of Ih in generation of theta and gamma in hippocampus: 151282 (Neymotin et al. 2013)

Generation and modulation of gamma oscillations: fast spiking interneurons in Ca1 182843 (Ferguson et al. 2013), persistent gamma in neocortical slice 156072 (Tomsett et al. 2014), modulation of gamma by basket cell extrasynaptic inhibition 155601 (Proddutur et al., 2013)

Role of gap junctions: synchronization of interneurons in striatum 156260 (Damodaran et al. 2014)

## ***Specific phenomena other than rhythmic activity***

Decision making: interaction of top-down and bottom-up inputs in sensory processing 168867 (Wimmer et al. 2015)

Striatal states: state-dependence of calcium fluctuations in striatal medium spiny neurons 150912 (Evans et al. 2013), 151458 spike-timing dependent synaptically elicited calcium fluctuations in dendritic spines during up and down states (Nakano et al. 2013)

Default mode activity: default mode network model 169775 (Matsui et al. 2014)

Functional roles of noise: promotion of independent control of gamma oscillations and grid firing 183017 (Solanka et al. 2015)

### ***Learning and memory***

Reinforcement learning: dopamine-dependent plasticity at corticostriatal synapses 151458 (Nakano et al. 2013), reinforcement learning algorithms 168143 (Nakano et al. 2015), determination of direction of learning by temporal pattern of activation 154967 (Kim et al. 2013), dopamine-related mechanisms involved in reinforcement learning 153573 (Morita and Kato, 2014)

Role of the CREB pathway: 151126 (Bianchi et al. 2014)

Working memory: L5 prefrontal cortex microcircuit generation of persistent activity 155057 (Papoutsis et al. 2014, 2013), model of working memory based on negative derivative feedback 181010 (Lim and Goldman, 2013)

Short term memory: mechanisms for efficient unsupervised learning 169983 (Vertechi, Brendel and Machens 2014)

Sensory learning: odor learning 146813 (de Almeida et al. 2013; Devore S, et al. 2014) olfactory memory and learning 155157 (Kaplan and Lansner 2014), learning of cortical color opponent receptive fields 152197 (Eguchi et al., 2014)

Motor learning: cerebellar memory consolidation 180823 (Yamazaki et al. 2015), fast convergence of cerebellar learning 150225 (Luque et al. 2015), adaptive gain control in cerebellum 150067 (Garrido et al., 2013), adaptive control of a robot by a cerebellar network model 167414 (Casellato et al. 2014)

Memory retrieval: roles of inhibitory interneurons 181967 (Cutsuridis and Poirazi 2015)

Conditioned fear: lateral amygdal model 150288 (Kim et al. 2013)

### ***Pathophysiology and potential therapeutic measures***

Hypertension: role of autonomic nervous system 151482 (Briant et al. 2014)

Alteration of neuronal function by cytokines: increased excitability of layer 5-6 pyramidal cells by type 1 interferons 168148 (Reetz et al. 2014; Stadler et al. 2014)

Retinal degenerative disorders: mechanisms of retinal oscillations in mouse model of retinal degeneration 156781 (Choi et al. 2014)

Axonal transport: mechanism of axonal transport of proteins and organelles 153740 (Koon et al. 2014)

Effects of electrical fields: on neuronal function 151731 (Cavarretta et al. 2014), on hippocampal rhythms 144589 (Berzhanskaya et al. 2013)

Mass lesions and brain trauma: effects of mechanical deformation on passive and active propagation of electrical signals in neurons 168861 (Garcia-Grajales et al. 2015)

### ***Channelopathies***

Potassium channels: relationship of R213Q and R312W Kv7.2 mutations in Ca1 pyramidal neurons to epileptogenesis 148094 (Miceli et al. 2013)

Sodium channels: relationship of SCN1A mutation for Nav1.1 to familial hemiplegic migraine 167715 (Dahlem et al. 2014)

### ***Epilepsy (also see Channelopathies)***

Effects of seizure-induced concentration changes on neuronal dynamics: 169023 (Krishnan et al. 2015)

Relationship between normal and pathological high frequency oscillations (ripples) in hippocampus: 182134 (Fink et al. 2015)

Thalamocortical epileptogenesis in primary generalized epilepsy: 182906 (Zhao et al., 2015)

Mechanisms of seizure suppression by brain stimulation: 168856 (Taylor et al. 2014), 152113 (Chen et al., 2014)

Relationship between mechanism of epileptogenesis and potentially therapeutic measures: 155565 (Wang et al. 2014)

Seizure-induced alterations of cells and circuits: alteration of dentate basket cell inhibition by status epilepticus 155602 (Yu J et al 2013), increased excitability in dentate gyrus following status epilepticus 155568 (Tejada et al. 2014), modification of cortical rhythms by epilepsy 155601 (Proddutur et al., 2013), effect of status epilepticus on spontaneous spikes in hippocampus 142104 (Stanley et al. 2013)

### **Parkinson's disease**

Mechanisms of abnormal synchronization: 169984 (Damodaran et al. 2015), 147366 (Kerr et al. 2013)  
Deep brain stimulation: mechanisms of therapeutic failure 148637 (Dovzhenok et al. 2013)

### **Alzheimer's disease** (also see **Methods for therapeutic application of electrical stimulation**)

Amyloid beta: effects on release probability and integration at CA3-CA1 synapses 147757 (Romani et al. 2013)

### **Nonneural cells and systems**

Mechanical interaction between whisker and ambient surfaces during haptic exploration: 151677 (Hires et al. 2013)

Cardiac arrhythmias: role of gap junctions 150691 (Casaleggio et al. 2014)

### ***Experimental methods and interpretation of results***

Neuronal morphometric data: methods and uses of 148644 (Parekh & Ascoli 2013), interpretation of 146950 (McDougal et al. 2013)

Spine head calcium as a proxy for sum of weighted synaptic inputs: 154732 (Graham et al. 2014)

Compensation for space clamp errors: 152028 (Gunay et al. 2015)

### **Optimization**

"Parameter peeling" in optimization of empirically based models: 151825 (Almog and Korngreen 2014)

Software for fitting neuronal models: Optimizer 156162 (Friedrich et al. 2014)

Experimental and computational estimation of cellular phase-response curves: 155735 (Couto et al. 2015)

Analysis of time series data: 154927 (Cohen 2014)

### **Methods for therapeutic application of electrical stimulation**

Spinal cord stimulation: stimulation of WDR dorsal horn network for treatment of chronic neuropathic pain 168414 (Zhang et al. 2014)

Neuromodulation in Alzheimer's disease: low intensity electrical brain stimulation to prevent synaptic scaling driven disease progression 154096 (Rowan et al. 2014)

Intracranial microstimulation: sensory prosthesis by stimulation of S1 pyramidal cells and interneurons 147460 (Overstreet et al., 2013)

Mechanism of action of deep brain stimulation: for epilepsy 152113 (Chen et al., 2014), for Parkinson's disease 148637 (Dovzhenok et al. 2013)

Quantification of network architectures: measure of network symmetry 151692 (Esposito et al. 2014)

### **Simulation methods**

Molecular networks: MAPK cascade model for random parameter sampling analysis 146024 (Mai and Liu 2013)

Reaction-diffusion: Python-based toolkits for STEPS 153351 (Chen and De Schutter 2014)

Comparison of IP3R models: 147367 (Hituri and Linne 2013)

Stochastic channel gating: approximating Monte Carlo simulation of ligand-gated channels 150207 (Montes et al. 2013), comparison of stochastic algorithms 167772 (Pezo et al. 2014)

NMDAergic synaptic transmission: 145836 (Moradi et al. 2013)

Channelrhodopsin gating models: 150804 (Stefanescu et al. 2013), 151549 (Williams et al. 2013)  
models of light- and voltage-dependent gating of channelrhodopsin-2 channels

Simplified models of neurons and networks: fractional leaky integrate-and-fire model 155856 (Teka et al. 2014), empirically based simplified Ca1 pyramidal neuron model 182515 (Ferguson et al. 2014), using Strahler's analysis to reduce complexity of neuronal models 149000 (Marasco et al. 2013), method for deriving input-output relationship of Hodgkin-Huxley style spiking neuron models 144993 (Soudry and Meir 2014), reduction of a network model to a mean field model 146499 (Nicola and Campbell, 2013), formulation of neural mass model based on dynamics of single neurons 155130 (Zandt et al. 2014)

Empirically based synthesis of neuronal morphologies for use in mechanistic models of networks: 182135 (Koene et al. 2009, van Ooyen et al. 2014), 151681 (Migliore et al. 2014), 167638 (Schneider et al. 2014)

Method for including electrical properties of extracellular space in individual neuron models: 149737 (Wang K et al. 2013)

Simulation of models that combine electrical and biochemical phenomena: 150284 (Mattioni & Le Novère 2013)

Empirically based functional modeling: cochlea 169278 (Zilany et al. 2009, 2014; Holmberg M 2007)

Multiple unit recordings: 147487 (Camunas-Mesa and Qurioga 2013)

Field potentials: 147172 (beim Graben and Serafim 2013), 152112 (Goldwyn et al. 2014), 156072 (Tomsett et al. 2014)

Spiking network simulators: Norns (Neural Network Studio) 154739 (Visser and Van Gils 2014)