Notations

$\mathbb{K}$	the set $\mathbb{R}$ of real numbers or the set $\mathbb{C}$ of complex numbers
$\mathbb{Z}$	set of integers
$\mathbb{R}_+$	$\{t \in \mathbb{R} : t \geq 0\}$
$\mathbb{R}_{>0}$	$\{t \in \mathbb{R} : t > 0\}$
$\mathbb{N}$	set of strictly positive integers
$\mathbb{N}_0$	$\mathbb{N} \cup \{0\}$
$s \wedge t$	$\min(s,t)$; minimum of two real numbers s and t
$\dot{x} = \frac{d}{dt}\, x$	differentiation of a function x with respect to the time variable t
$U' = \frac{d}{dx}\, U$	differentiation of a function $U(x)$ with respect to the space variable x
$\nabla U \,,\ \nabla_x U$	$\begin{pmatrix} \frac{\partial U}{\partial x_1} \\ \vdots \\ \frac{\partial U}{\partial x_d} \end{pmatrix}$; gradient of the function U with respect to the multi-dimensional space variable $x = (x_1, \ldots, x_d)$
$\Delta f \,,\ \Delta_x f$	$\frac{\partial^2 f}{\partial x_1^2} + \cdots + \frac{\partial^2 f}{\partial x_d^2}$; Laplacian of the real-valued function f with respect to the multi-dimensional space variable $x = (x_1, \ldots, x_d)$
$a := b \,,\ b =: a$	a is defined by b
$a \equiv b$	a equals b by definition
$f(x) \equiv c$	the function f attains the constant value c for all x
$\asymp$	$T(\varepsilon) \asymp \mathrm{e}^{\zeta/\varepsilon}$ denotes logarithmic equivalence of a function $T(\varepsilon)$ (which is defined for small values of ε, i.e. $T : (0, \varepsilon_0) \to \mathbb{R}_{>0}$) to $\mathrm{e}^{\zeta/\varepsilon}$ in the sense that $\lim\limits_{\varepsilon \to 0} \varepsilon \log T(\varepsilon) \;=\; \zeta$; see p.100
$\perp\!\!\!\perp$	stochastic independence of two objects with respect to a prescribed measure
$\xrightarrow{\ \mathbb{P}\ }$	convergence in probability
$\xrightarrow{\ w\ }$	weak convergence (convergence in distribution)

$(\alpha \to \beta)$	arrow with initial point α and endpoint β; see p.92
$\langle\ ,\ \rangle$	scalar product of the underlying space $\mathbb{K}^n$ ($\mathbb{R}^n$ or $\mathbb{C}^n$)
$\lvert\ \rvert$	norm of the underlying space $\mathbb{K}^n$ ($\mathbb{R}^n$ or $\mathbb{C}^n$)
$\lVert\ \rVert$	operator norm
$\lVert\ \rVert_\infty$, $\lVert\ \rVert_{[T_1,T_2]}$	supremum (maximum) norm on the space of (continuous) functions $f : [T_1, T_2] \to \mathbb{R}^n$; $\lVert f \rVert_\infty \equiv \lVert f \rVert_{[T_1,T_2]} := \sup_{t \in [T_1,T_2]} \lvert f(t) \rvert$
1_M	indicator function of the set M
∂M	topological boundary of the set M
$\overline{M}$	topological closure of the set M
M°	topological interior of the set M
$\lfloor t \rfloor$	$\max\{k \in \mathbb{N}_0 : k \leq t\}$; integer part of $t \in \mathbb{R}_+$ ("Gaußbracket" or "floor" of t)
$\operatorname{Im} z$	imaginary part of the complex number z
$\operatorname{Re} z$	real part of the complex number z
$\bar{z}$	complex conjugate of the number z (exception: drift function $\bar{h}$ of α_t^ε)
a	$\sigma\,\sigma^*$; εa is the covariance matrix of X^ε in the SDE (2.1)
$\hat{a}$	$\hat{\sigma}\,\hat{\sigma}^*$ corresponding to the SDE (3.1) for $\mathcal{X}^\varepsilon$
$\mathfrak{a} > 0$	small parameter in the Jordan-form matrix calculations; see the proofs of theorems 1.4.3 and 4.1.2
α_t^ε	angle of the solution Z_t^ε of the linear differential system (1); characterized by the differential equation (1.6)
$\mathcal{A}_1$	attracting switching curve of the angle processes under consideration; see p.18f.
$\mathcal{A}_2$	repelling switching curve of the angle processes under consideration; see p.18f.
$\mathbf{A}$	system matrix of the SDE (1) given by a continuous function $\mathbf{A} : \mathbb{R}^d \to \mathbb{K}^{n \times n}$
A^*	adjoint operator (matrix) for an operator A
b	drift coefficient of the SDE (2.1) for $(X_t^\varepsilon)_{t \geq 0}$
$\hat{b}$	(component of the) drift coefficient of the SDE (3.1) for $(\mathcal{X}_t^\varepsilon, \mathcal{Y}_t^\varepsilon)_{t \geq 0}$
$\mathcal{B}(X)$	Borel-σ-algebra on the topological space X
$B(x, r)$	$\{\, y \in \mathbb{R}^d : \lvert x - y \rvert < r\}$; open ball with center x and radius r
$B_r(x)$	$\{\, y \in \mathbb{R}^d : \lvert x - y \rvert \leq r\}$; closed ball with center x and radius r

$\complement M$	$E \setminus M$; set-theoretical complement of $M \subset E$
$C^k(M,N)$	$\{f : M \to N$ continuous, all derivatives of f of order up to k exist and are continuous$\}$ for differentiable manifolds M, N and $k \in \mathbb{N}_0$
$C(M,N)$	$C^0(M,N)$
$C^b(\mathbb{R}^d,\mathbb{R})$	$\{f \in C(\mathbb{R}^d,\mathbb{R}) : f \text{ bounded}\}$
$C^c(\mathbb{R}^d,\mathbb{R})$	$\{f \in C(\mathbb{R}^d,\mathbb{R}) : \mathrm{supp}(f) \text{ compact}\}$
$C_x(J,M)$	$\{f : J \to M$ continuous, $f(0) = x\}$ for an interval $J \subset \mathbb{R}$, $0 \in J$, a differentiable manifold M and $x \in M$
$\mathcal{C}^{(k)}$	set of k-cycles; see p.93ff.

d	dimension of the state space of $(X_t^\varepsilon)_{t\geq 0}$ as defined in (2.1)
D	bounded, open domain in $\mathbb{R}^d$ to which the exit time investigations in the non-degenerate case apply; see 2.4.1ff.
$\mathcal{D}$	bounded, open domain in $\mathbb{R}^m$ to which the exit time investigations in the degenerate case apply; see 3.1.1ff.
D_i	$\{x \in \mathbb{R}^d \,:\, X_t^{0,x} \xrightarrow{t\to\infty} K_i\}$; the domain of attraction of K_i under the deterministic motion X^0; see p.79
δ_{ij}	1 if $i = j$ and 0 otherwise; Kronecker symbol
$\delta_x(B)$	1 if $x \in B$ and 0 otherwise; Dirac measure at x
$\det(A)$	determinant of the matrix A
$\mathrm{dist}(x,B)$	$\inf_{y\in B} \lvert x-y \rvert$; distance between the point $x \in \mathbb{R}^d$ and the set $B \subset \mathbb{R}^d$
$\mathrm{div}\, b$	$\frac{\partial b_1}{\partial x_1} + \cdots + \frac{\partial b_d}{\partial x_d}$; divergence of the vector-valued function b

$e_1, \ldots, e_d$	canonical unit vectors in $\mathbb{R}^d$
$\varepsilon \geq 0$	parameter of the noise intensity in SDEs (1), (2.1) and (3.1)
$\mathbb{E}(f)$	$\int f \, d\mathbb{P}$; expected value of the function f with respect to the probability measure $\mathbb{P}$
$\mathbb{E}^{\mathcal{F}}$	conditional expectation with respect to the σ-algebra $\mathcal{F}$
$\mathbb{E}_x$	expected value with respect to the probability measure $\mathbb{P}_x$
$\mathcal{E}(C)$	exit rate of the cycle C; see p.93ff.

F	(component of the) drift coefficient of the SDE (3.1) for $(\mathcal{X}_t^\varepsilon, \mathcal{Y}_t^\varepsilon)_{t\geq 0}$
F	continuous mapping between separable metric spaces "pushing forward" the LDP; see p.68
$\mathcal{F}_X$	σ-algebra generated by the random variable X
$\mathbb{F}_{x_0,\zeta}$	$\{\, x \in \mathbb{R}^d \,:\, V(x_0,x) \leq \zeta \,\}$; the set to which X^ε is asymptotically constrained on the time scale $T(\varepsilon)$; see corollary 2.5.7

$\mathfrak{g}$	graph on $\mathfrak{L}$, i.e. a set of arrows; see p.92
$G_W(\mathfrak{L})$	the set of W-graphs on $\mathfrak{L}$; see p.92f.
$G_i(\mathfrak{L})$	the set of i-graphs on $\mathfrak{L}$; see p.92f.
Γ	parameter for the (scaled) time horizon; see p.102ff.
$\mathcal{G}^\varepsilon$	$\sum_{i=1}^d b_i \frac{\partial}{\partial x_i} + \frac{\varepsilon}{2} \sum_{i,j=1}^d a_{ij} \frac{\partial^2}{\partial x_i \, \partial x_j}$; generator of the diffusion process $(X_t^\varepsilon)_{t \geq 0}$; see p.53
$\mathbf{G}$, $\mathbf{G}^\varepsilon$	perturbations of the system matrix $\mathbf{A}$
$\mathbb{G}^0$, $\mathbb{G}^+$, $\mathbb{G}^+_T$	point sets corresponding to the data of the SDE (3.1); see p.128ff.
$GL(n, \mathbb{K})$	general linear group, consisting of the invertible $n \times n$ matrices with entries in $\mathbb{K}$
$h(x, \psi)$	$\mathbf{A}(x)\psi \, - \, \langle \, \mathbf{A}(x)\psi \, , \, \psi \, \rangle \, \psi$; drift function of the direction ψ_t^ε of the solution Z_t^ε of the linear differential system (1); see RDE (1.4)
$\bar{h}(x, \alpha)$	$- \, a_{12}(x) \, \sin^2 \alpha \, + \, a_{21}(x) \, \cos^2 \alpha$ $+ \big(a_{22}(x) - a_{11}(x) \big) \, \sin \alpha \, \cos \alpha$; drift function of the angle α_t^ε of the solution Z_t^ε of the linear differential system (1); see RDE (1.6)
$\mathbb{H}_{x_0, \zeta}$	$\{ \, x \in \mathbb{R}^d \, : \, V(K_{\mu(x_0,\zeta)}, x) \leq \zeta \, \}$; the set where X^ε gets asymptotically stuck on the time scale $T(\varepsilon)$; see corollary 2.5.8
$H_{\scriptscriptstyle U}$	$\left(\frac{\partial^2 U}{\partial x_i \, \partial x_j} \right)_{i,j=1,\dots,d}$; Hesse matrix of U, i.e. the symmetric matrix of second derivatives of the potential function $U \in C^2(\mathbb{R}^d, \mathbb{R})$
$H_1 \equiv H_1([0,T], \mathbb{R}^d)$	$\left\{ \, \int_0^T g(s) \, ds \; : \; g \in L^2([0,T], \mathbb{R}^d) \, \right\}$; the space of absolutely continuous functions starting in 0 with L^2-derivative
$\mathcal{H}(s, x, p)$	$\sum_{i=1}^d \hat{b}_i(s,x) \, p_i \, - \, \frac{1}{2} \sum_{i,j=1}^d \hat{a}_{ij}(s,x) \, p_i \, p_j$; see p.135
$I_n = \mathrm{id}_{\mathbb{K}^n}$	identity operator on $\mathbb{K}^n$ (unit matrix)
$I : E \to [0, \infty]$	rate function, defined on a separable metric space (mostly a function space) E; see p.68ff.
$\mathcal{J}$	index singling out the (local) Lyapunov exponent in the list of eigenvalues; see p.38ff. and p.160ff.
$J(C)$	cycle following after the cycle C; see p.93ff.
$K_1, \dots, K_l$	stable attractors of X^0
$K_{l+1}, \dots, K_{l'}$	unstable attractors of X^0
$K_{\mu(x_0,\zeta)}$	metastable state for the initial value x_0 and the time scale $T(\varepsilon) \asymp \mathrm{e}^{\zeta/\varepsilon}$; see definition 2.5.4

$\mathcal{K}(s,x,q)$	$\frac{1}{2}\big\vert\, \hat{a}(s,x)^{-1/2}\,[\,q-\hat{b}(s,x)]\,\big\vert^2$; dual function of $\mathcal{H}(s,x,p)$; see 3.1.2 and p.135

l	number of the stable attractors K_i of X^0
$\mathfrak{L}$	$\{1,\dots,l\}$; enumeration representing the set of stable attractors $\{K_1,\dots,K_l\}$ of X^0 ; see p.91
$\mathbb{L}$	Lebesgue measure
$\mathrm{L}(x)$	vector field such that $b(x)=-\nabla U(x)+\mathrm{L}(x)$ and $\mathrm{L}(x)\perp\nabla U(x)$, where such a decomposition exists
$L^p([a,b],\mathbb{R}^d)$	space of (equivalence classes of the) $\mathbb{R}^d$-valued, Lebesgue-measurable functions on $[a,b]$ such that their norm is $p-$integrable with respect to the Lebesgue measure $\mathbb{L}$
$\mathcal{L}^\varepsilon$	$\mathcal{G}^\varepsilon + h\,\frac{\partial}{\partial s}$; generator of the coupled (Markov) process $(X_t^\varepsilon,\psi_t^\varepsilon)$; see p.14
$\hat{\mathcal{L}}^\varepsilon$	$\sum_{i=1}^d \hat{b}_i\,\frac{\partial}{\partial x_i}+\frac{\varepsilon}{2}\sum_{i,j=1}^d \hat{a}_{ij}\,\frac{\partial^2}{\partial x_i\,\partial x_j}+\sum_{i=1}^m F_i\,\frac{\partial}{\partial y_i}$; generator of the coupled (Markov) process $(\mathcal{X}_t^\varepsilon,\mathcal{Y}_t^\varepsilon)$; see p.128
$\Lambda_1(\mathbf{A})\,,\,\dots\,,\,\Lambda_n(\mathbf{A})$	eigenvalues (characteristic roots, i.e zeros of the characteristic polynomial in the complex plane) of the $n\times n$-matrix $\mathbf{A}$

$M(C)$	main state of the cycle C; see p.93ff.
$m(C)$	stationary distribution rate of the cycle C; see p.93ff.
μ	the index function which assigns the respective metastable state $K_{\mu(x_0,\zeta)}$ to the initial value x_0 and to the time scale parameter ζ ; see (2.21)

n	dimension of the state space of $(Z_t^\varepsilon)_{t\geq 0}$ as defined in (1)
$N(x),N(y)$	outer normal vector to ∂D at x or to $\partial\mathcal{D}$ at y, respectively

$\mathcal{O}$	stable attractor of X^0 in the first exit time investigations (element of $\{K_1,\dots,K_l\}$); see p.78ff.
$(\Omega,\mathcal{F},\mathbb{P})$	underlying probability space

$p\equiv p(\mathbf{A})$	number of distinct values in the set of real parts of eigenvalues $\{\mathrm{Re}\,\Lambda_1,\dots,\mathrm{Re}\,\Lambda_n\}$ of the matrix $\mathbf{A}$
$\mathbb{P}_{s,z}$	law of the stochastic process Z conditioned to start in z at time $s\geq 0$; $\mathbb{P}_{s,z}\{Z\in M\}=\mathbb{P}\{Z_s=z\wedge Z\in M\}$

$\mathbb{P}_z$	$\mathbb{P}_{0,z}$; law of Z conditioned to start in z at time 0
$P(t,x,A)$, $P_t^\varepsilon(x,A)$	Markov transition probabilities
$p_t^\varepsilon(x,y)$	density of $P_t^\varepsilon(x,A)$
$p^\varepsilon(x)$	density of ρ^ε ; see section 2.2
P^{n-1}	$\{s \in \mathbb{R}^n : \|s\| = 1\}/\{s = -s\}$; projective space in $\mathbb{R}^n$
$\mathrm{pr}_{[0,T]}$	$\mathrm{pr}_{[0,T]} : (\mathbb{R}^d)^{[0,\infty)} \to (\mathbb{R}^d)^{[0,T]}$, $\mathrm{pr}_{[0,T]}(f) := f\big\|_{[0,T]}$; restriction map on the function space
ϕ	prefactor of the Verhulst comparison ODE; see 4.3.3f.
Φ^ε	cocycle solution of (1.1); see section 1.3
ψ_t^ε	$\frac{Z_t^\varepsilon}{\|Z_t^\varepsilon\|} \in S^{n-1}$ spherical component (direction) of the solution Z_t^ε of the linear differential system (1); characterized by the differential equation (1.4)
Ψ	set on which large deviation estimate is supposed to hold; see p.68, p.74
$\mathcal{P}^\varepsilon(s,x,y)$	inclusion probability; see p.130
$\mathcal{Q}^\varepsilon(s,x,y)$	exit probability; see p.130
Q_0 , Q , Q_1	parameter domains for the SDE (3.1); see p.128ff.
$Q(x,\psi)$	$\big\langle\, \mathbf{A}(x)\psi \,,\, \psi \,\big\rangle$; integral function identifying the modulus of the solution Z_t^ε of the linear differential system (1); see (1.3) and (1.5)
$\bar{Q}(x,\alpha)$	$a_{11}(x)\,\cos^2\alpha \,+\, a_{22}(x)\,\sin^2\alpha \,+\, \big(a_{12}(x) + a_{21}(x)\big)\,\sin\alpha\;\cos\alpha$; integral function identifying the modulus of the solution Z_t^ε of the linear differential system (1) in dimension $n = 2$; see (1.7) and (1.8)
$R(C)$	rotation rate of the cycle C; see p.93ff.
ρ^ε	stationary distribution of X^ε; see section 2.2
ϱ_t^ε	$\|\, Z_t^\varepsilon \,\| \in (0,\infty)$ radial component (modulus) of the solution Z_t^ε of the linear differential system (1); characterized by the differential equation (1.3)
s	time parameter
S^{n-1}	$\{\, \psi \in \mathbb{R}^n : \|\psi\| = 1\}$; unit sphere of $\mathbb{R}^n$
$S_r(x)$	$\{\, y \in \mathbb{R}^d : \|x - y\| = r\}$; sphere with center x and radius r
σ	noise coefficient of the SDE (2.1) for $(X_t^\varepsilon)_{t\geq 0}$
$\hat{\sigma}$	noise coefficient of the SDE (3.1) for $(\mathcal{X}_t^\varepsilon, \mathcal{Y}_t^\varepsilon)_{t\geq 0}$

$\sigma(\mathcal{M})$	σ-algebra generated by a family $\mathcal{M}$ of sets or functions
$\sigma_\rho^{\varepsilon,x}$	$\inf\{t \geq 0 \,:\, X_t^{\varepsilon,x} \in B_\rho(\mathcal{O}) \cup \partial D\}$; first hitting time of $X_\bullet^{\varepsilon,x}$ of either ∂D or a small neighborhood of $\mathcal{O}$; see 2.4.9
t	time parameter
$\tau^{\varepsilon,x} \equiv \tau_D^{\varepsilon,x}$	$\inf\{t \geq 0 \,:\, X_t^{\varepsilon,x} \notin D\}$; first exit time of $X_\bullet^{\varepsilon,x}$ from a bounded, open domain D in $\mathbb{R}^d$ with smooth boundary ∂D; see 2.4.1
$\mathcal{T}^{\varepsilon,y} \equiv \mathcal{T}_{\mathcal{D}}^{\varepsilon,x}$	$\inf\{t \geq 0 \,:\, \mathcal{Y}_t^{\varepsilon,x} \notin \mathcal{D}\}$; first exit time of $\mathcal{Y}_\bullet^{\varepsilon,y}$ from a bounded, open domain $\mathcal{D}$ in $\mathbb{R}^m$ with smooth boundary $\partial\mathcal{D}$; see 3.1.1
$\tau_m^{\varepsilon,x}$, $\theta_{m+1}^{\varepsilon,x}$	stopping times in the proof of the exit time law; see p.86
T	$T \geq 0$; fixed time horizon
$T(\varepsilon)$	$T(\varepsilon) \asymp \mathrm{e}^{\zeta/\varepsilon}$; time scale on which the respective sublimiting distribution is observed; see theorem 2.5.5
trace(A)	trace of the matrix A
U	$U \in C^\infty(\mathbb{R}^d, \mathbb{R})$; potential function
$(W_t)_{t\geq 0}$	Brownian motion in $\mathbb{R}^d$ over a complete probability space $(\Omega, \mathcal{F}, \mathbb{P})$
x, x_0	space variable (element in $\mathbb{R}^d$) ; initial point of the stochastic processes X, X^ε and $\mathcal{X}^\varepsilon$; for X^ε in (2.1), the initial condition is taken from $\bigcup_{i=1}^l D_i$, a set of full Lebesgue measure, in order to have the metastability results available
ξ_t^ε	$\tan \alpha_t^\varepsilon$; characterized by the differential equation (1.9)
y_0	initial point of the stochastic processes Y and $\mathcal{Y}^\varepsilon$
ζ	parameter which determines the time scale $T(\varepsilon) \asymp \mathrm{e}^{\zeta/\varepsilon}$; for the index function $\mu(x_0, \zeta)$ to be well defined, ζ must not be contained in a finite exceptional set depending on x_0
$X \equiv (X_t)_{t\geq 0}$	real noise process
$X^\varepsilon \equiv (X_t^\varepsilon)_{t\geq 0}$	diffusion process of Freidlin-Wentzell type as defined in (2.1)
$\mathcal{X}^\varepsilon \equiv (\mathcal{X}_t^\varepsilon)_{t\geq 0}$	diffusion process driving the SDE (3.1)
$Y \equiv (Y_t)_{t\geq 0}$	solution process of a real noise SDE driven by X
$\mathcal{Y}^\varepsilon \equiv (\mathcal{Y}_t^\varepsilon)_{t\geq 0}$	solution process of the real noise SDE (3.1) driven by $\mathcal{X}^\varepsilon$

$Z^\varepsilon \equiv (Z^\varepsilon_t)_{t\geq 0}$	solution process of the linear real noise SDE (1) driven by X^ε
$X^\varepsilon_\bullet, Z^\varepsilon_\bullet, \ldots$	$t \mapsto X^\varepsilon_t$ or $Z^\varepsilon_t, \ldots$; path mappings of the respective processes
LDP	large deviation principle
ODE	ordinary differential equation
PDE	partial differential equation
RDE	random differential equation
RDS	random dynamical system
RVDE	random Riccati-/Verhulst-type differential equality
RVDI	random Riccati-/Verhulst-type differential inequality
SDE	stochastic differential equation
cf.	confer
e.g.	for example (exempli gratia)
et al.	and others (et alii)
i.e.	that is (id est)
p.	page(s)

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