AMS/IP Studies in Advanced Mathematics

Volume 31

Higher Franz-Reidemeister Torsion

Kiyoshi Igusa

TECHNISCHE INFORMATIONSBIBLIOTHEK UNIVERSITÄTESTELOTHEK HAMI, S

American Mathematical Society · International Press





Contents

2.1The space of invertible matrices242.1.1The space $\mathcal{W}_{\bullet}(R, G, n)$ 272.1.2The Volodin category $\mathcal{V}_{\bullet}(R, n)$ 282.1.3The involution on $\mathcal{W}_{\bullet}(R, G, n)$ 292.1.4Functorial properties of $\mathcal{W}_{\bullet}(R, G, n)$ 322.2 $\mathcal{W}_{\bullet}^{cont}(\mathbb{C}^m, n)$ and $\mathcal{W}_{\bullet}^{diff}(\mathbb{C}^m, n)$ 332.3The isovariant subcomplex of $\mathcal{W}_{\bullet}^{cont}(\mathbb{C}^m, G, n)$ 392.4Higher FR-torsion for $\mathcal{W}_{\bullet}^{diff}(\mathbb{C}^m, U(m), n)$ 422.4.1Cyclic homology442.4.2Properties of $\tau_k(m, n)$ 552.5Stabilization of $\mathcal{W}_{\bullet}(R, G, n)$ 552.6Higher FR-torsion for oriented S^1 -bundles562.6.1Morse theory572.7Higher FR-torsion in the isovariant case612.8Transfer and polylogarithms632.9Framed functions on S^1 692.10Combinatorial framings743AModel for the Whitehead Space833.1Multiple mapping cylinders843.2Morphisms of multiple mapping cylinders93	Lis	st of	Figures	$\mathbf{x}\mathbf{i}$			
1Color of the second seco	In	trodu	action	xiii			
1.1.1The smooth Volodin space of C51.2First formula for the cocycle71.3The correction term91.3.1Cyclic homology101.4 D_{2k} gives the Borel regulator map131.5The involution in $V_n(\mathbb{C})$ 141.6Additivity of τ_k^V 161.7Some computations172Spaces of Matrices and Higher FR-Torsion232.1The space of invertible matrices242.1.1The space $\mathcal{W}_{\bullet}(R, G, n)$ 272.1.2The Volodin category $\mathcal{V}_{\bullet}(R, n)$ 282.1.3The involution on $\mathcal{W}_{\bullet}(R, G, n)$ 292.1.4Functorial properties of $\mathcal{W}_{\bullet}(R, G, n)$ 332.3The isovariant subcomplex of $\mathcal{W}_{\bullet}^{cont}(\mathbb{C}^m, G, n)$ 392.4Higher FR-torsion for $\mathcal{W}_{\bullet}^{diff}(\mathbb{C}^m, U(m), n)$ 422.4.1Cyclic homology442.4.2Properties of $\tau_k(m, n)$ 492.5Stabilization of $\mathcal{W}_{\bullet}(R, G, n)$ 552.6Higher FR-torsion for oriented S^1 -bundles562.6.1Morse theory572.7Higher FR-torsion in the isovariant case612.8Transfer and polylogarithms632.9Framed functions on S^1 692.10Combinatorial framings743AModel for the Whitehead Space833.1Multiple mapping cylinders643.2Morphisms of multiple mapping cylinders64	1	Cocycles in Volodin K-Theory					
1.11		1.1					
1.3The formula function form91.3.1Cyclic homology101.4 D_{2k} gives the Borel regulator map131.5The involution in $V_n(\mathbb{C})$ 141.6Additivity of τ_k^V 161.7Some computations172Spaces of Matrices and Higher FR-Torsion232.1The space of invertible matrices242.1.1The space $\mathcal{W}_{\bullet}(R, G, n)$ 272.1.2The Volodin category $\mathcal{V}_{\bullet}(R, n)$ 282.1.3The involution on $\mathcal{W}_{\bullet}(R, G, n)$ 292.1.4Functorial properties of $\mathcal{W}_{\bullet}(n, G, n)$ 322.2 $\mathcal{W}_{\bullet}^{cont}(\mathbb{C}^m, n)$ and $\mathcal{W}_{\bullet}^{diff}(\mathbb{C}^m, n)$ 332.3The isovariant subcomplex of $\mathcal{W}_{\bullet}^{cont}(\mathbb{C}^m, G, n)$ 392.4Higher FR-torsion for $\mathcal{W}_{\bullet}^{diff}(\mathbb{C}^m, U(m), n)$ 422.4.1Cyclic homology442.4.2Properties of $\tau_k(m, n)$ 512.5.1Properties of $\tau_k(m, n)$ 552.6Higher FR-torsion for oriented S^1 -bundles562.6.1Morse theory572.7Higher FR-torsion in the isovariant case612.8Transfer and polylogarithms632.9Framed functions on S^1 692.10Combinatorial framings743A Model for the Whitehead Space833.1Multiple mapping cylinders643.2Morphisms of multiple mapping cylinders65							
1.3.1Cyclic homology101.4 D_{2k} gives the Borel regulator map131.5The involution in $V_n(\mathbb{C})$ 141.6Additivity of τ_k^V 161.7Some computations172Spaces of Matrices and Higher FR-Torsion232.1The space of invertible matrices242.1.1The space $W_{\bullet}(R, G, n)$ 272.1.2The Volodin category $V_{\bullet}(R, n)$ 282.1.3The involution on $W_{\bullet}(R, G, n)$ 292.1.4Functorial properties of $W_{\bullet}(R, G, n)$ 332.3The isovariant subcomplex of $W_{\bullet}^{cont}(\mathbb{C}^m, G, n)$ 392.4Higher FR-torsion for $W_{\bullet}^{diff}(\mathbb{C}^m, U(m), n)$ 422.4.1Cyclic homology442.4.2Properties of $\tau_k(m, n)$ 552.6Higher FR-torsion for oriented S^1 -bundles562.6.1Morse theory572.7Higher FR-torsion in the isovariant case612.8Transfer and polylogarithms632.9Framed functions on S^1 632.9Framed functions on S^1 632.9Framed functions on S^1 632.9Framed functions on S^1 632.9Morphisms of multiple mapping cylinders843.1Multiple mapping cylinders84		1.2	First formula for the cocycle				
1.4 D_{2k} gives the Borel regulator map131.5The involution in $V_n(\mathbb{C})$ 141.6Additivity of τ_k^V 161.7Some computations172Spaces of Matrices and Higher FR-Torsion232.1The space of invertible matrices242.1.1The space $W_{\bullet}(R, G, n)$ 272.1.2The Volodin category $V_{\bullet}(R, n)$ 282.1.3The involution on $W_{\bullet}(R, G, n)$ 282.1.4Functorial properties of $W_{\bullet}(R, G, n)$ 322.2 $W_{\bullet}^{cont}(\mathbb{C}^m, n)$ and $W_{\bullet}^{diff}(\mathbb{C}^m, n)$ 332.3The isovariant subcomplex of $W_{\bullet}^{cont}(\mathbb{C}^m, G, n)$ 392.4Higher FR-torsion for $W_{\bullet}^{diff}(\mathbb{C}^m, U(m), n)$ 422.4.1Cyclic homology442.4.2Properties of $\tau_k(m, n)$ 552.5Stabilization of $W_{\bullet}(R, G, n)$ 552.6Higher FR-torsion for riented S^1 -bundles562.6.1Morse theory572.7Higher FR-torsion of oriented S^1 -bundles562.6.1Morse theory572.7Higher FR-torsion in the isovariant case612.8Transfer and polylogarithms632.9Framed functions on S^1 692.10Combinatorial framings743A Model for the Whitehead Space833.1Multiple mapping cylinders93		1.3					
1.5The involution in $V_n(\mathbb{C})$ 141.6Additivity of τ_k^V 161.7Some computations172Spaces of Matrices and Higher FR-Torsion232.1The space of invertible matrices242.1.1The space $\mathcal{W}_{\bullet}(R, G, n)$ 272.1.2The Volodin category $\mathcal{V}_{\bullet}(R, n)$ 282.1.3The involution on $\mathcal{W}_{\bullet}(R, G, n)$ 292.1.4Functorial properties of $\mathcal{W}_{\bullet}(R, G, n)$ 292.1.4Functorial properties of $\mathcal{W}_{\bullet}(R, G, n)$ 322.2 $\mathcal{W}_{\bullet}^{cont}(\mathbb{C}^m, n)$ and $\mathcal{W}_{\bullet}^{diff}(\mathbb{C}^m, n)$ 332.3The isovariant subcomplex of $\mathcal{W}_{\bullet}^{cont}(\mathbb{C}^m, G, n)$ 392.4Higher FR-torsion for $\mathcal{W}_{\bullet}^{diff}(\mathbb{C}^m, U(m), n)$ 422.4.1Cyclic homology442.4.2Properties of $\tau_k(m, n)$ 512.5Stabilization of $\mathcal{W}_{\bullet}(R, G, n)$ 562.6Higher FR-torsion of oriented S^1 -bundles562.6.1Morse theory572.7Higher FR-torsion in the isovariant case612.8Transfer and polylogarithms632.9Framed functions on S^1 692.10Combinatorial framings743A Model for the Whitehead Space833.1Multiple mapping cylinders843.2Morphisms of multiple mapping cylinders93							
1.6Additivity of τ_k^{V} 1.6Additivity of τ_k^{V} 1.61.7Some computations172Spaces of Matrices and Higher FR-Torsion232.1The space of invertible matrices242.1.1The space $W_{\bullet}(R, G, n)$ 272.1.2The Volodin category $V_{\bullet}(R, n)$ 282.1.3The involution on $W_{\bullet}(R, G, n)$ 292.1.4Functorial properties of $W_{\bullet}(R, G, n)$ 322.2 $W_{\bullet}^{oont}(\mathbb{C}^m, n)$ and $W_{\bullet}^{oiff}(\mathbb{C}^m, n)$ 332.3The isovariant subcomplex of $W_{\bullet}^{oont}(\mathbb{C}^m, G, n)$ 392.4Higher FR-torsion for $W_{\bullet}^{diff}(\mathbb{C}^m, U(m), n)$ 422.4.1Cyclic homology442.4.2Properties of $\tau_k(m, n)$ 512.5Stabilization of $W_{\bullet}(R, G, n)$ 552.6Higher FR-torsion for riented S^1 -bundles562.6.1Morse theory572.7Higher FR-torsion in the isovariant case612.8Transfer and polylogarithms632.9Framed functions on S^1 632.9Framed functions on S^1 633.1Multiple mapping cylinders843.2Morphisms of multiple mapping cylinders93		1.4					
1.3Nutletity of N_k 1.11.11.11.7Some computations172Spaces of Matrices and Higher FR-Torsion232.1The space $\mathcal{M}_{\bullet}(R, G, n)$ 242.1.1The space $\mathcal{W}_{\bullet}(R, G, n)$ 272.1.2The Volodin category $\mathcal{V}_{\bullet}(R, n)$ 282.1.3The involution on $\mathcal{W}_{\bullet}(R, G, n)$ 292.1.4Functorial properties of $\mathcal{W}_{\bullet}(R, G, n)$ 322.2 $\mathcal{W}_{\bullet}^{cont}(\mathbb{C}^m, n)$ and $\mathcal{W}_{\bullet}^{diff}(\mathbb{C}^m, n)$ 332.3The isovariant subcomplex of $\mathcal{W}_{\bullet}^{cont}(\mathbb{C}^m, G, n)$ 392.4Higher FR-torsion for $\mathcal{W}_{\bullet}^{diff}(\mathbb{C}^m, U(m), n)$ 422.4.1Cyclic homology442.4.2Properties of $\tau_k(m, n)$ 492.5Stabilization of $\mathcal{W}_{\bullet}(R, G, n)$ 552.6Higher FR-torsion of oriented S^1 -bundles562.6.1Morse theory572.7Higher FR-torsion in the isovariant case612.8Transfer and polylogarithms632.9Framed functions on S^1 692.10Combinatorial framings743A Model for the Whitehead Space833.1Multiple mapping cylinders843.2Morphisms of multiple mapping cylinders93		1.5	The involution in $V_n(\mathbb{C})$				
2Spaces of Matrices and Higher FR-Torsion232.1The space of invertible matrices		1.6	Additivity of τ_k^V				
2.1The space of invertible matrices242.1.1The space $\mathcal{W}_{\bullet}(R, G, n)$ 272.1.2The Volodin category $\mathcal{V}_{\bullet}(R, n)$ 282.1.3The involution on $\mathcal{W}_{\bullet}(R, G, n)$ 292.1.4Functorial properties of $\mathcal{W}_{\bullet}(R, G, n)$ 322.2 $\mathcal{W}_{\bullet}^{cont}(\mathbb{C}^m, n)$ and $\mathcal{W}_{\bullet}^{diff}(\mathbb{C}^m, n)$ 332.3The isovariant subcomplex of $\mathcal{W}_{\bullet}^{cont}(\mathbb{C}^m, G, n)$ 392.4Higher FR-torsion for $\mathcal{W}_{\bullet}^{diff}(\mathbb{C}^m, U(m), n)$ 422.4.1Cyclic homology442.4.2Properties of $\tau_k(m, n)$ 552.5Stabilization of $\mathcal{W}_{\bullet}(R, G, n)$ 552.6Higher FR-torsion for oriented S^1 -bundles562.6.1Morse theory572.7Higher FR-torsion in the isovariant case612.8Transfer and polylogarithms632.9Framed functions on S^1 692.10Combinatorial framings743AModel for the Whitehead Space833.1Multiple mapping cylinders843.2Morphisms of multiple mapping cylinders93		1.7	Some computations	17			
2.1The space of invertible matrices242.1.1The space $\mathcal{W}_{\bullet}(R, G, n)$ 272.1.2The Volodin category $\mathcal{V}_{\bullet}(R, n)$ 282.1.3The involution on $\mathcal{W}_{\bullet}(R, G, n)$ 292.1.4Functorial properties of $\mathcal{W}_{\bullet}(R, G, n)$ 322.2 $\mathcal{W}_{\bullet}^{cont}(\mathbb{C}^m, n)$ and $\mathcal{W}_{\bullet}^{diff}(\mathbb{C}^m, n)$ 332.3The isovariant subcomplex of $\mathcal{W}^{cont}(\mathbb{C}^m, G, n)$ 392.4Higher FR-torsion for $\mathcal{W}_{\bullet}^{diff}(\mathbb{C}^m, U(m), n)$ 422.4.1Cyclic homology442.4.2Properties of $\tau_k(m, n)$ 512.5.1Properties of $\tau_k(m, n)$ 552.6Higher FR-torsion of oriented S^1 -bundles562.6.1Morse theory572.7Higher FR-torsion in the isovariant case612.8Transfer and polylogarithms632.9Framed functions on S^1 692.10Combinatorial framings743AModel for the Whitehead Space833.1Multiple mapping cylinders843.2Morphisms of multiple mapping cylinders93	2	Spac	ces of Matrices and Higher FR-Torsion	23			
2.1.2The Volodin category $\mathcal{V}_{\bullet}(R, n)$ 282.1.3The involution on $\mathcal{W}_{\bullet}(R, G, n)$ 292.1.4Functorial properties of $\mathcal{W}_{\bullet}(R, G, n)$ 322.2 $\mathcal{W}_{\bullet}^{cont}(\mathbb{C}^m, n)$ and $\mathcal{W}_{\bullet}^{diff}(\mathbb{C}^m, n)$ 332.3The isovariant subcomplex of $\mathcal{W}_{\bullet}^{cont}(\mathbb{C}^m, G, n)$ 392.4Higher FR-torsion for $\mathcal{W}_{\bullet}^{diff}(\mathbb{C}^m, U(m), n)$ 422.4.1Cyclic homology442.4.2Properties of $\tau_k(m, n)$ 512.5Stabilization of $\mathcal{W}_{\bullet}(R, G, n)$ 552.6Higher FR-torsion of oriented S^1 -bundles562.6.1Morse theory572.7Higher FR-torsion in the isovariant case612.8Transfer and polylogarithms632.9Framed functions on S^1 692.10Combinatorial framings743A Model for the Whitehead Space833.1Multiple mapping cylinders843.2Morphisms of multiple mapping cylinders93				24			
2.1.3The involution on $\mathcal{W}_{\bullet}(R, G, n)$ 292.1.4Functorial properties of $\mathcal{W}_{\bullet}(R, G, n)$ 322.2 $\mathcal{W}_{\bullet}^{cont}(\mathbb{C}^m, n)$ and $\mathcal{W}_{\bullet}^{diff}(\mathbb{C}^m, n)$ 332.3The isovariant subcomplex of $\mathcal{W}_{\bullet}^{cont}(\mathbb{C}^m, G, n)$ 392.4Higher FR-torsion for $\mathcal{W}_{\bullet}^{diff}(\mathbb{C}^m, U(m), n)$ 422.4.1Cyclic homology442.4.2Properties of $\tau_k(m, n)$ 512.5.1Properties of $\tau_k(m, n)$ 552.6Higher FR-torsion of oriented S^1 -bundles562.6.1Morse theory572.7Higher FR-torsion in the isovariant case612.8Transfer and polylogarithms632.9Framed functions on S^1 632.10Combinatorial framings743A Model for the Whitehead Space833.1Multiple mapping cylinders843.2Morphisms of multiple mapping cylinders93			2.1.1 The space $\mathcal{W}_{\bullet}(R,G,n)$				
2.1.4Functorial properties of $\mathcal{W}_{\bullet}(R, G, n)$ 322.2 $\mathcal{W}_{\bullet}^{cont}(\mathbb{C}^m, n)$ and $\mathcal{W}_{\bullet}^{diff}(\mathbb{C}^m, n)$ 332.3The isovariant subcomplex of $\mathcal{W}_{\bullet}^{cont}(\mathbb{C}^m, G, n)$ 392.4Higher FR-torsion for $\mathcal{W}_{\bullet}^{diff}(\mathbb{C}^m, U(m), n)$ 422.4.1Cyclic homology442.4.2Properties of $\tau_k(m, n)$ 492.5Stabilization of $\mathcal{W}_{\bullet}(R, G, n)$ 512.5.1Properties of $\tau_k(m)$ 552.6Higher FR-torsion of oriented S^1 -bundles562.6.1Morse theory572.7Higher FR-torsion in the isovariant case612.8Transfer and polylogarithms632.9Framed functions on S^1 692.10Combinatorial framings743A Model for the Whitehead Space833.1Multiple mapping cylinders843.2Morphisms of multiple mapping cylinders93			2.1.2 The Volodin category $\mathcal{V}_{\bullet}(R,n)$	28			
2.2 $\mathcal{W}^{cont}_{\bullet}(\mathbb{C}^m, n)$ and $\mathcal{W}^{diff}_{\bullet}(\mathbb{C}^m, n)$ 332.3The isovariant subcomplex of $\mathcal{W}^{cont}_{\bullet}(\mathbb{C}^m, G, n)$ 392.4Higher FR-torsion for $\mathcal{W}^{diff}_{\bullet}(\mathbb{C}^m, U(m), n)$ 422.4.1Cyclic homology442.4.2Properties of $\tau_k(m, n)$ 492.5Stabilization of $\mathcal{W}_{\bullet}(R, G, n)$ 512.5.1Properties of $\tau_k(m)$ 552.6Higher FR-torsion of oriented S^1 -bundles562.6.1Morse theory572.7Higher FR-torsion in the isovariant case612.8Transfer and polylogarithms632.9Framed functions on S^1 692.10Combinatorial framings743A Model for the Whitehead Space833.1Multiple mapping cylinders843.2Morphisms of multiple mapping cylinders93			2.1.3 The involution on $\mathcal{W}_{\bullet}(R,G,n)$	29			
2.3 The isovariant subcomplex of $\mathcal{W}^{cont}_{\bullet}(\mathbb{C}^m, G, n)$ 392.4 Higher FR-torsion for $\mathcal{W}^{diff}_{\bullet}(\mathbb{C}^m, U(m), n)$ 422.4.1 Cyclic homology442.4.2 Properties of $\tau_k(m, n)$ 492.5 Stabilization of $\mathcal{W}_{\bullet}(R, G, n)$ 512.5.1 Properties of $\tau_k(m)$ 552.6 Higher FR-torsion of oriented S^1 -bundles562.6.1 Morse theory572.7 Higher FR-torsion in the isovariant case612.8 Transfer and polylogarithms632.9 Framed functions on S^1 643 A Model for the Whitehead Space833.1 Multiple mapping cylinders843.2 Morphisms of multiple mapping cylinders93			2.1.4 Functorial properties of $\mathcal{W}_{\bullet}(R,G,n)$	32			
2.3 The isovariant subcomplex of $\mathcal{W}^{cont}_{\bullet}(\mathbb{C}^m, G, n)$ 392.4 Higher FR-torsion for $\mathcal{W}^{diff}_{\bullet}(\mathbb{C}^m, U(m), n)$ 422.4.1 Cyclic homology442.4.2 Properties of $\tau_k(m, n)$ 492.5 Stabilization of $\mathcal{W}_{\bullet}(R, G, n)$ 512.5.1 Properties of $\tau_k(m)$ 552.6 Higher FR-torsion of oriented S^1 -bundles562.6.1 Morse theory572.7 Higher FR-torsion in the isovariant case612.8 Transfer and polylogarithms632.9 Framed functions on S^1 643 A Model for the Whitehead Space833.1 Multiple mapping cylinders843.2 Morphisms of multiple mapping cylinders93		2.2	$\mathcal{W}^{cont}(\mathbb{C}^m, n)$ and $\mathcal{W}^{diff}(\mathbb{C}^m, n)$	33			
2.4Higher FR-torsion for $\mathcal{W}_{\bullet}^{\bullet,T}(\mathbb{C}^m, U(m), n)$ 422.4.1Cyclic homology442.4.2Properties of $\tau_k(m, n)$ 492.5Stabilization of $\mathcal{W}_{\bullet}(R, G, n)$ 512.5.1Properties of $\tau_k(m)$ 552.6Higher FR-torsion of oriented S^1 -bundles562.6.1Morse theory572.7Higher FR-torsion in the isovariant case612.8Transfer and polylogarithms632.9Framed functions on S^1 692.10Combinatorial framings743A Model for the Whitehead Space833.1Multiple mapping cylinders843.2Morphisms of multiple mapping cylinders93			The isovariant subcomplex of $\mathcal{W}^{cont}(\mathbb{C}^m, G, n)$	39			
2.4.1Cyclic homology442.4.2Properties of $\tau_k(m, n)$ 492.5Stabilization of $\mathcal{W}_{\bullet}(R, G, n)$ 512.5.1Properties of $\tau_k(m)$ 552.6Higher FR-torsion of oriented S^1 -bundles562.6.1Morse theory572.7Higher FR-torsion in the isovariant case612.8Transfer and polylogarithms632.9Framed functions on S^1 692.10Combinatorial framings743A Model for the Whitehead Space833.1Multiple mapping cylinders843.2Morphisms of multiple mapping cylinders93			Higher FB-torsion for $\mathcal{W}^{diff}(\mathbb{C}^m, U(m), n)$	42			
2.4.2 Properties of $\tau_k(m, n)$ 492.5 Stabilization of $\mathcal{W}_{\bullet}(R, G, n)$ 512.5.1 Properties of $\tau_k(m)$ 552.6 Higher FR-torsion of oriented S^1 -bundles562.6.1 Morse theory572.7 Higher FR-torsion in the isovariant case612.8 Transfer and polylogarithms632.9 Framed functions on S^1 692.10 Combinatorial framings743 A Model for the Whitehead Space833.1 Multiple mapping cylinders843.2 Morphisms of multiple mapping cylinders93		2.1					
2.5Stabilization of $\mathcal{W}_{\bullet}(R, G, n)$ 512.5.1Properties of $\tau_k(m)$ 552.6Higher FR-torsion of oriented S^1 -bundles562.6.1Morse theory572.7Higher FR-torsion in the isovariant case612.8Transfer and polylogarithms632.9Framed functions on S^1 743A Model for the Whitehead Space833.1Multiple mapping cylinders843.2Morphisms of multiple mapping cylinders93							
2.5.1Properties of $\tau_k(m)$.552.6Higher FR-torsion of oriented S^1 -bundles562.6.1Morse theory572.7Higher FR-torsion in the isovariant case612.8Transfer and polylogarithms632.9Framed functions on S^1 692.10Combinatorial framings743A Model for the Whitehead Space833.1Multiple mapping cylinders843.2Morphisms of multiple mapping cylinders93		2.5	Stabilization of $W_{\bullet}(R, G, n)$	51			
2.6 Higher FR-torsion of oriented S ¹ -bundles 56 2.6.1 Morse theory 57 2.7 Higher FR-torsion in the isovariant case 61 2.8 Transfer and polylogarithms 63 2.9 Framed functions on S ¹ 63 2.10 Combinatorial framings 74 3 A Model for the Whitehead Space 83 3.1 Multiple mapping cylinders 84 3.2 Morphisms of multiple mapping cylinders 93		2.0	2.5.1 Properties of $\tau_k(m)$	55			
2.6.1 Morse theory 57 2.7 Higher FR-torsion in the isovariant case 61 2.8 Transfer and polylogarithms 63 2.9 Framed functions on S^1 69 2.10 Combinatorial framings 74 3 A Model for the Whitehead Space 83 3.1 Multiple mapping cylinders 84 3.2 Morphisms of multiple mapping cylinders 93		2.6	Higher FR-torsion of oriented S^1 -bundles	56			
2.7 Higher FR-torsion in the isovariant case 61 2.8 Transfer and polylogarithms 63 2.9 Framed functions on S ¹ 69 2.10 Combinatorial framings 74 3 A Model for the Whitehead Space 83 3.1 Multiple mapping cylinders 84 3.2 Morphisms of multiple mapping cylinders 93		2.0					
2.8 Transfer and polylogarithms 63 2.9 Framed functions on S ¹ 69 2.10 Combinatorial framings 74 3 A Model for the Whitehead Space 83 3.1 Multiple mapping cylinders 84 3.2 Morphisms of multiple mapping cylinders 93		2.7					
2.9 Framed functions on S ¹ 69 2.10 Combinatorial framings 74 3 A Model for the Whitehead Space 83 3.1 Multiple mapping cylinders 84 3.2 Morphisms of multiple mapping cylinders 93							
2.10 Combinatorial framings 74 3 A Model for the Whitehead Space 83 3.1 Multiple mapping cylinders 84 3.2 Morphisms of multiple mapping cylinders 93							
3.1 Multiple mapping cylinders 84 3.2 Morphisms of multiple mapping cylinders 93							
3.1 Multiple mapping cylinders 84 3.2 Morphisms of multiple mapping cylinders 93	3	A٦	Aodel for the Whitehead Space	83			
3.2 Morphisms of multiple mapping cylinders	Ŭ			84			
ch	-		Morphisms of multiple mapping cylinders	. 93			
3.3 Mapping cones $\ldots \ldots \ldots$		3.3	Mapping cones	102			
3.4 Morphisms of bundles and the twisted homology bundle 107			Morphisms of bundles and the twisted homology bundle	. 107			

	3.5	Uniqueness of the fiberwise cone				
	3.6	A model for the stabilized Whitehead space \hdotspace				
4	Morse Theory and Filtered Chain Complexes 135					
-	4.1	Comparison with filtered chain complexes				
	4.2	Morse theory and filtered chain complexes				
	4.3	The G -monomial functor of a family of				
	7.0	Morse functions				
	4.4	G-expansion functor of a family of GMF's				
	4.5	Independence of birth-death points				
	4.6	The framed function theorem				
	4.0					
5	Hon	notopy Type of the Whitehead Space 173				
	5.1	Filtered endomorphisms				
	5.2	The G -monomial category				
	5.3	Expansions in filtered chain complexes				
	5.4	The involution on Whitehead space				
	5.5	Poincaré duality and conjugate transpose				
	5.6	Waldhausen K-theory				
	5.7	Higher FR-torsion and the 2-index theorem				
		5.7.1 The suspension theorem				
		5.7.2 Properties of higher FR-torsion				
		5.7.3 Higher FR-torsion of oriented sphere bundles				
	5.8	The involution again				
	5.9	Proof of the 2-index theorem 229				
6	The	Framing Principle and Bökstedt's Theorem 237				
0	6.1	The framing principle				
	6.2	Pseudoisotopies				
	6.3	Cerf's approach				
	6.4	Hatcher's construction				
	6.5	The involution on $\mathcal{C}(M)$				
	6.6	FR-torsion for fiber products				
	0.0					
7	\mathbf{Pro}	of of Complexified Bökstedt Theorem 257				
	7.1	Systems of local sections for S^1 -bundles $\ldots \ldots \ldots \ldots \ldots \ldots 258$				
	7.2	Smoothly varying incidence matrices				
	7.3	Another version of the integral invariant				
	7.4	Explicit local sections for the canonical S^1 -bundle over $(S^2)^k$. 264				
	7.5	Reduction to isolated regions				
	7.6	An explicit variable incidence matrix				
	7.7	Polylogarithms as functions on S^1	,			
	7.8	Simplification of the integral)			
	7.9	Partitions and necklaces	i			
		7.9.1 Descending partitions	i			
		7.9.2 Necklaces	ł			

viii

	7.9.3	Counting necklaces	293
7.1	.0 Staten	nent of the Theorem	295
8 Fr	amed G		297
8.1	. Graph	ns and metric graphs	298
8.2	Frame	ed graphs	308
8.3	Comp	arison with framed functions	314
8.4	The fr	amed graph theorem	318
	8.4.1	Trees, magma and homotopy framings	318
	8.4.2	Homotopy framed trees admit unique framings	322
	8.4.3	Existence, uniqueness of homotopy framings of trees	325
	8.4.4	Framing families of graphs	330
8.5	i Applie	cations of the framed graph theorem	332
	8.5.1	Framing of graphs and the homology of $Out(F_n)$	332
	8.5.2	Higher FR-torsion of the Torelli group	341
8.6	5 Fat gr	aphs give framed functions	345
	8.6.1	Fat graphs	346
	8.6.2		
	8.6.3	Proof of Lemmas 8.6.5 and 8.6.6	353
Biblie	ography	•	359

Index

365