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Generalized blow-up of corners and fiber products

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(Submitted on 17 Jul 2011)

Radial blow-up, including inhomogeneous versions, of boundary faces of a manifold (always with corners) is an important tool for resolving singularities, degeneracies and competing notions of homogeneity. These constructions are shown to be particular cases of `generalized boundary blow-up' in which a new manifold and blow-down map are constructed from, and conversely determine, combinatorial data at the boundary faces in the form of a refinement of the `basic monoidal complex' of the manifold. This data specifies which notion of homogeneity is realized at each of the boundary hypersurfaces in the blown-up space.

As an application of this theory, the existence of fiber products is examined for the natural smooth maps in this context, the b-maps. Transversality of the b-differentials is shown to ensure that the set-theoretic fiber product of two maps is a `binomial variety'. Properties of these (extrinsically defined) spaces, which generalize manifolds but have mild singularities at the boundary, are investigated and a condition on the basic monoidal complex is found under which the variety has a smooth structure. Applied to b-maps this additional condition with transversality leads to a universal fiber product in the context of manifolds with corners. Under the transversality condition alone the fiber product is resolvable to a smooth manifold by generalized blow-up and then has a weaker form of the universal mapping property requiring blow-up of the domain.

Comments:	55 pages
Subjects:	**Geometric Topology (math.GT)**; Differential Geometry (math.DG)
Cite as:	**arXiv:1107.3320 [math.GT]**
	(or **arXiv:1107.3320v1 [math.GT]** for this version)

Submission history

From: Chris Kottke [view email]
[v1] Sun, 17 Jul 2011 18:02:21 GMT (58kb)

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