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Classification of Homotopy Types of Embedding Spaces into 2-Manifolds

This talk gives a complete description of the homotopy types of the connected components of spaces of embeddings of compact polyhedra into 2-manifolds. Suppose M is a connected 2-manifold and X is a compact connected subpolyhedron of M (X is neither one point, nor a closed 2-manifold). Let $E(X, M)$ denote the space of topological embeddings of X into M with the compact-open topology and $E(X, M)_0$ denote the connected component of inclusion i_X of X into M in $E(X, M)$. Homotopy type of $E(X, M)_0$ can be classified in term of subgroup $G = \mathrm{Im}\,[(i_X)_*\colon \pi_1(X) \to \pi_1(M)]$.

The main statements are:

(1) If G is not a cyclic group and M is neither T nor K, then $E(X, M)_0 \simeq \{pt\}$.

(2) If G is a nontrivial cyclic group and M is not P, T, or K, then $E(X, M)_0 \simeq S^1$.

(3) In Case $G = 1$,
  - (i) if X is an arc or M is orientable, then $E(X, M)_0 \simeq ST(M)$,
  - (ii) if X is not an arc and M is nonorientable, then $E(X, M)_0 \simeq ST(\tilde{M})$.

Here S^1 is the circle, T is the torus, P is the projective plane and K is the Klein bottle. $ST(M)$ denotes the tangent unit circle bundle of M with respect to any Riemannian metric of M and $\tilde{M}$ denotes the orientation double cover of M.