This talk will indicate how K-homology can be used to extend the Atiyah-Singer index formula to a naturally arising class of non-elliptic operators. K-homology is the dual theory to K-theory — i.e. K-homology is the homology theory determined by the Bott K-theory spectrum. For a finite CW complex $X$, the K-homology of $X$ can be defined via functional analysis and this gives the Kasparov groups $KK^*(C(X), \mathbb{C})$. A definition in the spirit of bordism theory uses $K$-cycles $(M, E, \varphi)$ where $M$ is a compact Spin$^c$ manifold without boundary, $E$ is a $\mathbb{C}$ vector bundle on $M$, and $\varphi$ is a continuous map from $M$ to $X$.

$$\varphi: M \longrightarrow X$$

Denote the $K$-cycle version of $K$-homology by $K^\top_*(X)$. The BD(Baum-Douglas) isomorphism

$$\mu: K^\top_*(X) \longrightarrow KK^*(C(X), \mathbb{C})$$

provides a framework for extending Atiyah-Singer beyond elliptic operators. The talk will first give the basic definitions, and will then show how the BD framework applies to a naturally arising class of hypoelliptic (but not elliptic) operators on contact manifolds. The above is joint work with Erik van Erp. (Received August 29, 2011)