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Rotation with zero angular momentum: Demonstrations of the falling cat phenomenon go sour

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It is well known that a system with zero angular momentum can, by appropriate deformations, rotate while preserving the condition of zero angular momentum. This effect explains how a cat that is dropped while upside down can turn over and of how certain gymnastic maneuvers are performed. These rotations are taken as a demonstration of the "non-integrability" of a "non-holonomic" constraint. There is a simple demonstration of this rotation-with-zero-angular-momentum effect with a rotating platform. But the demonstration often doesn't work because most floors are not perfectly flat. I found a simple better demonstration experiment. Unfortunately, the experiment came out all wrong for different reasons. But I figured out why and did a second demonstration experiment. And that came out wrong exactly in the opposite way. The talk presents the four puzzles: a) how can you turn while having zero angular momentum? b) Why does a rotating platform demonstration often not work. c) Why does a simple demonstration not work? d) Why does almost exactly the same demonstration not work in the opposite way? The talk starts with various personal stories about non-holonomic constraints and their relation to locomotion, like bikes skates and walking, and then gets into the 4 rotation puzzles.