CLAIMS

1. An amusement park attraction, comprising:

an attraction feature comprising a fluid actuator having an inflatable mass, the inflatable mass being fluidly connected to a source of pressurized fluid to enable inflation of the inflatable mass;

one or more fluid control devices configured to adjust inflation of the inflatable mass;

one or more sensors configured to monitor state properties of the fluid actuator; and

a controller communicatively coupled to the one or more fluid control devices and the one or more sensors, wherein the controller comprises instructions that when executed are configured to: controllably inflate the inflatable mass based at least on feedback from the one or more sensors to cause the fluid actuator to impact an object: calculate an impact force exerted by the fluid actuator on the object based at least on feedback from the one or more sensors; determine if the impact force is within a predetermined range; and control the inflation of the inflatable mass to adjust one or more parameters of the fluid actuator to maintain the impact force exerted by the fluid actuator on the object to within the predetermined range.

2. The amusement park attraction of claim 1, wherein the instructions are configured to calculate a maximum impact force (F(max)) of the fluid actuator against the object using the feedback from the one or more sensors, and to adjust the parameters of the fluid actuator so that the calculated F(max) is below a threshold in real-time.

3. The amusement park attraction of claim 1, wherein the instructions are configured to adjust operation of the one or more fluid control devices to maintain the one or more parameters exerted by the fluid actuator on the object to within the predetermined range in real-time.

4. The amusement park attraction of claim 3, wherein the one or more parameters of the fluid actuator comprise internal pressure, momentum, velocity, acceleration, mass, compliance, or any combination thereof, of the fluid actuator.

5. The amusement park attraction of claim 1, comprising a sound system, a light system, or both, and the instructions are configured to adjust operation of the sound system, the light system, or both, in concert with controlled inflation or deflation of the inflatable mass.

6. The amusement park attraction of claim 1, wherein the one or more sensors comprise a force sensor, a pressure sensor, a camera, a fluid property sensor, or any combination thereof.

7. The amusement park attraction of claim 1, wherein the controller is communicatively coupled to a ride vehicle of an amusement park, and wherein the instructions are configured to controllably inflate or deflate the inflatable mass based at least on operation of the ride vehicle to cause the attraction feature to impact a human guest on the ride vehicle, or to impact a part of the ride vehicle.

8. The amusement park attraction of claim 1, wherein the attraction feature comprises a plurality of fluid actuators, and wherein the plurality of fluid actuators is arranged in a pattern that defines a shape of the attraction feature.

9. The amusement park attraction of claim 1, wherein the instructions are configured to control the inflation of the inflatable mass to adjust a motion profile of the fluid actuator to maintain the impact force exerted by the fluid actuator on the object to within the predetermined range.

10. The amusement park attraction of claim 1, wherein the instructions are configured to control the inflation of the inflatable mass to adjust one or more object compliant properties of the fluid actuator to maintain the force exerted by the fluid actuator on the object to within the predetermined range.

11. The amusement park attraction of claim 1, wherein the instructions are configured to select either or both of controlling inflation of the inflatable mass to adjust one or more object compliant properties of the fluid actuator or controlling a motion profile of the fluid actuator to maintain the force exerted by the fluid actuator on the object to within the predetermined range.

12. A method of operating an attraction feature of an amusement park, comprising:

inflating a fluid actuator of the attraction feature to move the attraction feature along a motion profile to cause an interaction between the attraction feature and a target, the interaction comprising physical contact between the attraction feature and the target;

collecting information relating to the interaction between the attraction feature and the target using one or more sensors as the interaction is occurring; analyzing, via a controller in communication with the one or more sensors, the collected information from the one or more sensors to determine an interaction parameter associated with the interaction; and adjusting inflation of the fluid actuator as the interaction is occurring to maintain the interaction parameter within a target range.

13. The method of claim 12, wherein the interaction comprises physical contact between the fluid actuator of the attraction feature and the target, and wherein analyzing the collected information comprises continuously calculating a maximum impact force (F(max)) of the fluid actuator against the

target using the collected information, and wherein adjusting inflation of the fluid actuator comprises inflating or deflating the fluid actuator to adjust an object compliant property of the fluid actuator.

14. The method of claim 12, wherein adjusting inflation of the fluid actuator comprises inflating or deflating the fluid actuator to adjust the motion profile of the attraction feature.

15. The method of claim 14, wherein adjustment of the motion profile causes at least a portion of the attraction feature to move away from the target.

16. A pneumatic robotic system, comprising:

an attraction feature comprising a plurality of fluid actuators configured to provide a shape and a motion profile of the attraction feature in response to controlled inflation;

a fluid source fluidly coupled to the attraction feature and configured to provide pressurized fluid to the plurality of fluid actuators; one or more fluid control devices configured to control pressurized fluid flow from the fluid source to the plurality of fluid actuators;

one or more sensors associated with the attraction feature and configured to monitor state properties of the plurality of fluid actuators; and

a controller communicatively coupled to the one or more fluid control devices and to the one or more sensors, wherein the controller comprises instructions that when executed are configured to: analyze feedback from the one or more sensors relating to an interaction between the attraction feature and a target as the interaction is occurring to determine one or more interaction parameters associated with the interaction, wherein the interaction between the attraction feature and the target comprises physical contact between the attraction feature and the target; and adjust inflation of at least one fluid actuator of the plurality of fluid actuators to maintain the one or more interaction parameters within a predetermined range as the interaction is occurring.

17. The pneumatic robotic system of claim 16, wherein the instructions are configured to determine the one or more interaction parameters by continuously calculating a maximum impact force (F(max)) of the attraction feature against the target, and wherein the controller is configured to adjust inflation of at least one fluid actuator of the plurality of fluid actuators to adjust the motion profile of the attraction feature, or is configured to inflate or deflate at least one fluid actuator of the plurality of fluid actuators to adjust an object compliant property of the fluid actuator, or both, to maintain the one or more interaction parameters within the predetermined range as the interaction is occurring.

18. The pneumatic robotic system of claim 17, wherein the instructions are configured to control flow of the pressurized fluid to the plurality of fluid actuators to adjust a pressure difference across at least one fluid actuator of the plurality of fluid actuators or an average internal pressure of at least one fluid actuator of the plurality of fluid actuators.

19. The pneumatic robotic system of claim 16, wherein the one or more sensors comprise a force sensor, a pressure sensor, a camera, a fluid property sensor, or any combination thereof.

20. The pneumatic robotic system of claim 16, comprising a sound system, a light system, or both, and wherein the controller is configured to control operation of the sound system, the light system, or both, based on the motion profile of the attraction feature.