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Low-Dimple-Count Low-Drag Golf Ball & Method for Optimizing Dimple Design

Golfers often go to great lengths to improve their game, and the right ball can make a huge difference for an experienced player. The surface of a golf ball typically has 250-500 inverted dimples that may or may not be of equal size, and the arrangement of these dimples has a serious impact on performance. The United States Golf Association (USGA) requires that regulation golf balls be of a specified weight and diameter, and that the dimple pattern be "as symmetrical as possible," because an asymmetrical design can compensate for slicing (a mishit golf shot). Many existing designs implement geometric patterns of adjacent dimples that vary in diameter and depth and are arranged in an attempt to improve spin control and distance. However, most of what's known about effective dimple design has been discovered by trial and error with little scientific investigation by the manufacturers, resulting in golf balls that fail to offset the drag penalty incurred by having too many dimples.

Researchers at ASU have developed a computationally efficient method for optimizing dimple design and evaluating flight behaviors by direct numerical simulation (DNS) of the airflow around a golf ball. Typically, the computational cost of DNS is very high, but this method implements highly efficient parallel code that reduces processing payload enough to model the drag effects of each dimple. 3D digital prototypes can be modified for dimple count, depth, and diameter, while their placement is restricted only by symmetry. The dimples can be spherical, hexagonal, cylindrical, conical, or any other symmetric shape. The aerodynamic properties of the prototypes are used to calculate flight paths, with options for adjusting trajectory angle, ball orientation, spin, and initial velocity. This method reveals the physics of a flying golf ball at an intricate level of detail, giving manufacturers more scientific control over their empirical designs, and has facilitated the invention of a low-dimple-count golf ball with up to a 30% reduction in drag.

Potential Applications

- Computational Fluid Dynamic Software
- Fishing Lures
- Golf Balls
- Shotgun Pellets
- Space Capsules

Benefits and Advantages

- Accuracy – DNS modeling provides intricate detail to the effects of dimples on the overall airflow.
- Control – Gives real-time scientific insight for modifying golf ball

aerodynamics.

- Efficiency – Highly efficient parallel code reduces DNS processing time.
- Functionality
  - Dimple patterns can be modified for count, depth, diameter, and shape.
  - Trajectory angle, ball orientation, spin, and initial velocity can all be adjusted for testing flight behavior.
- Performance – Smoother surface and lower drag-to-lift ratio results in easier putting and longer drives while maintaining compliance with USGA regulations.

For more information about the inventor(s) and their research, please see

Dr. Kyle Squires' directory webpage