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A Certain Point Associated to a Cyclic Hexagon

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1. Introduction

Dao's theorem on six circumcenters [1] is a remarkable little result regarding points of concurrency in cyclic hexagon. Here we demonstrate a different result but one that is remarkably similar.

2. Results

Theorem 2.1. *For each side of a given cyclic hexagon, form a triangle through the two vertices and the center of the circumcircle of the hexagon. Then the lines connecting the circumcenters between opposite triangles are concurrent.*

Proof. Through each vertex of the hexagon, form the tangent line through that vertex. Now for each side of the hexagon, consider the two vertices, the center of the circumcircle of the hexagon, and the point formed by the two tangent lines. Since there are two right angles in the resulting quadrilateral, the point form a right kite and are therefore concyclic. But since the four points have the same circumcenter, and the two sides of the triangle are the same length, then by symmetry, the circumcenter of the triangle must be the midpoint of the center of the circumcircle of the hexagon and the point formed by the two tangents.
Now by Brianchon's theorem [2], the principal diagonals of the hexagon formed by the points where the tangent lines intersect are concurrent. But since the circumcenters of the triangles are the midpoints of those points, then the hexagon formed by the circumcenters of the triangles is similar to the hexagon formed

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by the tangent line intersections, and so its principal diagonals must also be concurrent by Brianchon's theorem. □

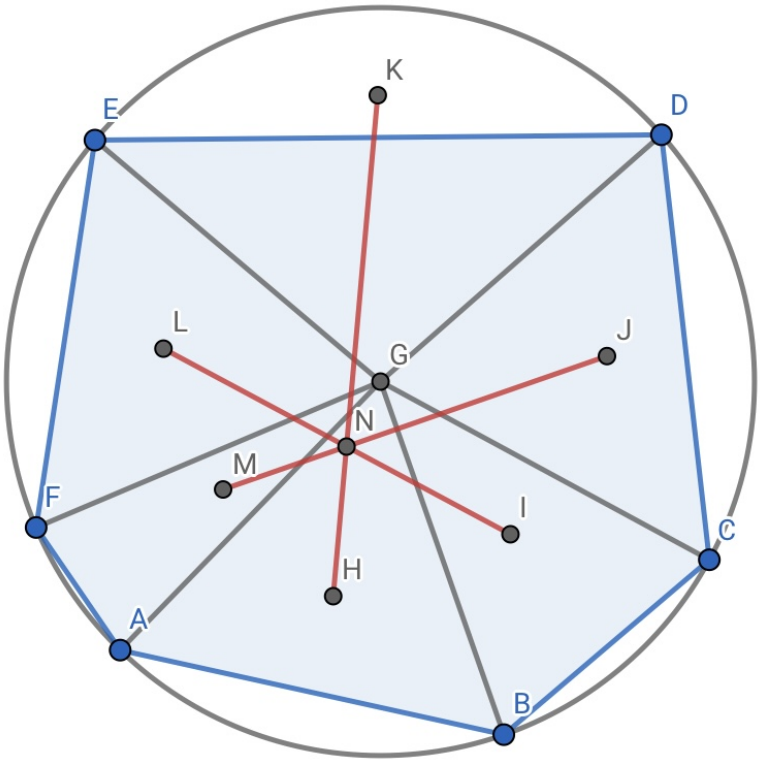

Figure 1.

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[2] Weisstein, Eric W. "Brianchon's Theorem." From *MathWorld–A Wolfram Web Resource*. https://mathworld.wolfram.com/BrianchonsTheorem.html.