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ON RADIO ANALYTIC MEAN Dd- DISTANCE NUMBER OF SOME MODERN GRAPHS

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ABSTRACT

A Radio analytic mean Dd-distance labeling of a connect graph G is an injective function f from the vertex set $V(G)$ to the $\mathbb{N}$ such that for two distinct vertices u and v of $G, D^{Dd}(u,v) + \left\lceil\frac{|f(u)^2 - f(v)^2|}{2}\right\rceil \geq 1 + diam^{Dd}(G), where\ D^{Dd}(u,v) = D(u,v) + \deg(u) + \deg(V), D^{Dd}(u,v)$ denotes the Dd-distance between u and v $diamD^{Dd}(G)$ denotes the Dd-diameter of G. The radio analytic mean Dd-distance number of f, $ramn^{Dd}$ (f) is the maximum label assigned to any vertex of G . The radio analytic mean Dd-distance number of f, $ramn^{Dd}(G)$is the minimum value of G, $ramn^{Dd}(G)$ is the minimum value of $ramn^{Dd}$ (f) taken over all radio analytic mean Dd-distance labeling f of G. In this paper we find the radio analytic mean Dd-distance number of some Modern graphs.

KEYWORDS: Dd-distance, radio analytic mean Dd-distance, radio analytic mean Dd-distance number.

1. INTRODUCTION

A graph $G = (V(G), E(G))$ we mean a finite undirected graph without loops or multiple edges. The O(G) and size of G are denotes by p and q respectively.

The Dd-distance concept was introduced by A. Anto Kinsley and P. Siva Ananthi. . We introduce the concept of radio analytic mean $Dd - distance$ number of some basic graphs. For a connected graph G, the Dd-length of a connected $u - v$ path is defined as $D^{Dd}(u,v) = D(u,v) + \deg(u) + \deg(V)$, The Dd-radius, denoted by r^{Dd} (G) is the minimum Dd-eccentricity among all vertices of G. That is r^{Dd} (G) $= min\{e^{Dd}(G) : v \in V(G)\}$. Similarly the Dd-diameter, $D^{Dd}(G)$ is the maximum Dd-eccentricity among all vertices of G. We observe that for any two vertices u , v of G, We have $d(u,v) \leq D^{Dd}(u,v)$. The equality holds if and only if u, v are identical. If G is any connected graph then the Dd-distance is a metric on the set of vertices of G. We can check easily $r^{Dd}(G) \leq D^{Dd}(G) \leq 2r^{Dd}(G)$. The lower bound is clear from the definition and the upper bound follows from the triangular inequality.

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P. Poomalai et al was introduced the concept of radio analytic mean labeling in 2019. we are introduced the concept of radio analytic mean Dd-distance. The radio analytic labeling is a function $f: V(G) \to \mathbb{N}$ such that $D^{Dd}(u,v) + \left\lceil \frac{|f(u)^2 - f(v)^2|}{2} \right\rceil \geq 1 + diam^{Dd}(G)$. We are introducing the radio analytic mean Dd-distance number of some Modern graphs.

Theorem 1.1

The Radio analytic mean Dd-distance number of a Closed Helm graph CH_n,

$ramn^{Dd}(CH_n) = 2n + 2 \; for \; all \; n.$

Proof

Let $V(CH_n) = \{v_0, v_1, v_2, v_3, \dots, v_n, u_1, u_2, u_3, \dots, u_n\}$ be the vertex set, where v_0 is the central vertex and $E(CH_n) = \{v_0 v_i, v_i u_i, v_i v_{i+1}, u_i u_{i+1} 1 \leq i \leq n\}$ be the edge set.

The Dd –distance $D^{Dd}(v_0, v_i) = 2n + 6, D^{Dd}(v_0, u_i) = 2n + 6,$

$$D^{Dd}(v_i, v_j) = 2n + 8, D^{Dd}(u_i, u_j) = 2n + 6,$$

$$D^{Dd}(u_i, v_j) = 2n + 7, 1 \leq i \leq n, 2 \leq j \leq n - 1, i \neq j.$$

Obviously, $diam^{Dd}(CH_n) = 2n + 8.$

By the radio analytic mean Dd-distance condition is

$$D^{Dd}(u,v) + \left\lceil \frac{|f(u)^2 - f(v)^2|}{2} \right\rceil \geq 1 + diam^{Dd}(G),$$

For every pair of vertices (u,v) where $u \neq v$.

Fix $f(v_0) = 2$

Now,

$$D^{Dd}(v_0, v_1) + \left\lceil \frac{|f(v_0)^2 - f(v_1)^2|}{2} \right\rceil \geq 1 + diam^{Dd}(CH_n)$$

$$\Rightarrow \left\lceil \frac{|(2)^2 - f(v_1)^2|}{2} \right\rceil \geq 3$$

Therefore, $f(v_1) = 3$

$$D^{Dd}(v_1, v_5) + \left\lceil \frac{|f(v_1)^2 - f(v_5)^2|}{2} \right\rceil \geq 1 + diam^{Dd}(CH_n),$$

$$\Rightarrow \left\lceil \frac{|(3)^2 - f(v_5)^2|}{2} \right\rceil \geq 1$$

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Therefore, $f(v_5) = 7$

Therefore, $f(v_1) = 3, f(v_2) = 4, f(v_3) = 5$, also, $f(v_4) = 6$,

$So, f(v_i) = i + 2 ,1 \leq i \leq n$

Therefore, $f(v_n) = n + 2$.

$$D^{Dd}(v_0, u_1) + \left\lceil \frac{|f(v_0)^2 - f(u_1)^2|}{2} \right\rceil \geq 1 + diam^{Dd}(CH_n)$$

$$\Rightarrow \left\lceil \frac{|(2)^2 - f(u_1)^2|}{2} \right\rceil \geq 3$$

Therefore, $f(u_1) = n + 3$

$$D^{Dd}(u_1, u_2) + \left\lceil \frac{|f(u_1)^2 - f(u_2)^2|}{2} \right\rceil \geq 1 + diam^{Dd}(CH_n)$$

$$\Rightarrow \left\lceil \frac{|(n+3)^2 - (f(u_2))^2|}{2} \right\rceil \geq 3$$

Therefore, $f(u_2) = n + 4$

Therefore, $f(u_1) = n + 3$, $f(u_2) = n + 4$, also, $f(u_3) = n + 5$

So, $f(u_i) = n + i + 2,1 \leq i \leq n$, Therefore, $f(u_n) = 2n + 2$.

Hence, $ramn^{Dd}\ (CH_n)\ \leq 2n + 2$ ....(1)

Since CH_n has 2n+1 vertices it requires 2n+1 distinct labels. Also by the radio analytic mean Dd-distance condition 1 labels between 1 and n are forbidden.

$$ramn^{Dd}\ (CH_n)) \geq (2n + 1) + 1$$

$$\geq\ 2n + 2 \ldots\ldots\ldots.(2)$$

From (1) and (2)
Hence, $ramn^{Dd}\ (CH_n) =\ 2n + 2\ for\ all\ n.$

Theorem 1.2

The Radio analytic mean Dd-distance number of a Double Wheel graph,

$ramn^{Dd}\ (W_{n,n}) =\ 4n - 4\ for\ all\ n.$

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Proof

Let $V(W_{n,n}) = \{v_0, v_1, v_2, v_3, \ldots, v_n\} \cup \{u_1, u_2, u_3, \ldots, u_n\}$ be the vertex set, where v_0 is the central vertex and $E(W_{n,n}) = \{v_0v_i, v_iv_{i+1}, v_0u_i, u_iu_{i+1} 1 \leq i \leq n\}$ be the edge set.

The Dd −distance $D^{Dd}(v_0, v_i) = 3n + 3, D^{Dd}(v_i, u_j) = 2n + 6,$

$D^{Dd}(v_0, u_i) = 3n + 3, D^{Dd}(v_i, v_j) = n + 6, D^{Dd}(u_i, u_j) = 2n + 6, 1 \leq i \leq n, 1 \leq j \leq n.$

Obviously, $diam^{Dd}(W_{n,n}) = 3n + 3.$

By the radio analytic mean Dd-distance condition is

$$D^{Dd}(u, v) + \left\lceil \frac{|`f(u)^2 - f(v)^2|}{2} \right\rceil \geq 1 + diam^{Dd}(G)$$

For every pair of vertices$(u, v)$where $u \neq v$.

Fix $f(v_0) = 1$

Now

$$D^{Dd}(v_0, v_1) + \left\lceil \frac{|f(v_0)^2 - f(v_1)^2|}{2} \right\rceil \geq 1 + diam^{Dd}(W_{n,n})$$

$$\Rightarrow \left\lceil \frac{|(1)^2 - (f(v_1))^2|}{2} \right\rceil \geq 1$$

$$\therefore f(v_1) = 2n - 3$$

$$D^{Dd}(v_1, v_2) + \left\lceil \frac{|f(v_1)^2 - f(v_2)^2|}{2} \right\rceil \geq 1 + diam^{Dd}(W_{n,n})$$

$$\Rightarrow \left\lceil \frac{|(2n-3)^2 - f(v_2)^2|}{2} \right\rceil \geq 2n - 2$$

$$\therefore f(v_2) = 2n - 2$$

Therefore, $f(v_1) = 2n - 3, f(v_2) = 2n - 2,$ So $f(v_i) = 2n + i - 4, 1 \leq i \leq n$

Therefore, $f(v_n) = 3n - 4$

Hence, $ramn^{Dd}((W_{n,n})) \leq 3n - 4$ …………(1)

Since $W_{n,n}$ has 2n+1 vertices it requires 2n+1 distinct labels. Also by the radio analytic mean Dd-distance condition (2n-5) labels between 1 and n are forbidden.

$$ramn^{Dd}(W_{n,n}) \geq (2n + 1) + (2n - 5)$$

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$$\geq\ 4n-4\ \ldots\ldots\ldots.(2)$$

From (1) and (2)
Hence, $ramn^{Dd}\left(W_{n,n}\right)=\ 4n-4 for\ all\ n.$

Theorem 1.3

The Radio analytic mean Dd-distance number of a Shell graph $C(n,n-3)$,

$ramn^{Dd}\left(C(n,n-3)\right)=\ 2n-6, n\geq 7.$

Proof

Let $V(C(n,n-3))=\ \{W_0,v_1,v_2,v_3,\ldots,v_{n-1}\}$ be the vertex set and $E(C(n,n-3))=\{w_0v_i,v_iv_{i+1},1\leq i\leq n-1\}$ be the edge set.

The Dd-distance $D^{Dd}(w_0,v_i)=2n,1\leq i\leq n,D^{Dd}\left(v_i,v_j\right)=n+4,D^{Dd}(v_i,v_k)=n+5,v_i,v_k$ are intermediate vertices.

Obviously, $diam^{Dd}(C(n,n-3))=2n.$

By the radio analytic mean Dd-distance condition is

$$D^{Dd}(u,v)+\left\lceil\frac{|f(u)^2-f(v)^2|}{2}\right\rceil\geq 1+diam^{Dd}(G),$$

For every pair of vertices (u,v) where $u\neq v$.

Fix $f(w_0)=1$

$$D^{Dd}(w_0,v_1)+\left\lceil\frac{|f(w_0)^2-f(v_1)^2|}{2}\right\rceil\geq 1+diam^{Dd}(C(n,n-3))$$

$$\Rightarrow\ \left\lceil\frac{|(1)^2-f(v_1)^2|}{2}\right\rceil\geq 1$$

$$\therefore f(v_1)=n-4$$

$$D^{Dd}(v_1,v_2)+\left\lceil\frac{|f(v_1)^2-f(v_2)^2|}{2}\right\rceil\geq 1+diam^{Dd}(C(n,n-3)),$$

$$\Rightarrow\left\lceil\frac{|(n-4)^2-\left(f(v_2)\right)^2|}{2}\right\rceil\geq n-2$$

$$\therefore f(v_2)=n-3$$

Therefore, $f(v_1)=n-4$, $f(v_2)=n-2$, So $f(v_i)=n-1+i-4,1\leq i\leq n-1$

Therefore, $f(v_{n-1})=2n-6.$

Hence, $ramn^{Dd}\left((C(n,n-3))\right)\ \leq 2n-6$ ....(1)

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Since G_n has n vertices it requires n distinct labels. Also by the radio analytic mean Dd-distance condition (n-6) labels between 1 and n are forbidden.

$$ramn^{Dd}\ (C(n, n-3)) \geq (\mathrm{n}) + (\mathrm{n}-6)$$

$$\geq\ 2n - 6\ \ldots\ldots\ldots.(2)$$

From (1) and (2)
Hence, $ramn^{Dd}\ (C(n, n-3)) =\ 2n-6, n \geq 7.$

Note: $ramn^{Dd}\ (C(n, n-3)) = n, if\ n = 3,4,5,6.$

Theorem 1.4

The Radio analytic mean Dd-distance number of a Sun Flower graph Sf_n,

$ramn^{Dd}\ (\ Sf_n) =\ 3n-5\ for\ all\ n.$

Proof

Let $V(\ Sf_n) = \{v_0\ , v_1\ , v_2, v_3, \ldots, v_n\ , u_1\ , u_2, u_3, \ldots, u_n\}$ be the vertex set, where v_0 is the central vertex and $E(\ Sf_n)\ =\ \{v_0v_i, v_iu_i, v_iv_{i+1}, u_iv_{i+1} 1 \leq i \leq n\}$ be the edge set.

The Dd –distance $D^{Dd}(v_0, v_i) = 3n+4, D^{Dd}(v_0, u_i) = 3n+2,$

$$D^{Dd}\left(v_i, v_j\right) = 2n+8, D^{Dd}\left(u_i, u_j\right) = 2n+4,$$

$$D^{Dd}\left(u_i, v_j\right) = 2n+6, 1 \leq i \leq n, 2 \leq j \leq n-1, i \neq j.$$

Obviously, $diam^{Dd}(\ Sf_n) = 3n+4.$

By the radio analytic mean Dd-distance condition is

$$D^{Dd}(u, v) + \left\lceil \frac{|f(u)^2 - f(v)^2\ |}{2} \right\rceil \geq 1 + diam^{Dd}(G),$$

For every pair of vertices (u, v) where $u \neq v$.

Fix $f(v_0) = 1$

Now,

$$D^{Dd}(v_0, v_1) + \left\lceil \frac{|f(v_0)^2 - f(v_1)^2\ |}{2} \right\rceil \geq 1 + diam^{Dd}(\ Sf_n)$$

$$\Rightarrow\ \left\lceil \frac{|(1)^2 - f(v_1)^2\ |}{2} \right\rceil \geq 1$$

Therefore, $f(v_1) = n-4$

$$D^{Dd}(v_1, v_2) + \left\lceil \frac{|f(v_1)^2 - f(v_2)^2\ |}{2} \right\rceil \geq 1 + diam^{Dd}(\ Sf_n),$$

$$\Rightarrow \left\lceil \frac{|(n-4)^2 - f(v_2)^2|}{2} \right\rceil \geq n-3$$

Therefore, $f(v_2) = n-3$

Therefore, $f(v_1) = n-4, f(v_2) = n-3, f(v_3) = n-2$, also, $f(v_4) = n-1$,

$So, f(v_i) = n+i-5, 1 \leq i \leq n$

Therefore, $f(v_n) = 2n-5$.

$$D^{Dd}(v_0, u_1) + \left\lceil \frac{|f(v_0)^2 - f(u_1)^2|}{2} \right\rceil \geq 1 + diam^{Dd}(Sf_n)$$

$$\Rightarrow \left\lceil \frac{|(1)^2 - f(u_1)^2|}{2} \right\rceil \geq 3$$

Therefore, $f(u_1) = 2n-4$

$$D^{Dd}(u_1, u_2) + \left\lceil \frac{|f(u_1)^2 - f(u_2)^2|}{2} \right\rceil \geq 1 + diam^{Dd}(Sf_n)$$

$$\Rightarrow \left\lceil \frac{|(2n-4)^2 - (f(u_2))^2|}{2} \right\rceil \geq n+1$$

Therefore, $f(u_2) = 2n-3$

Therefore, $f(u_1) = 2n-4$, $f(u_2) = 2n-3$, also, $f(u_3) = 2n-2$

So, $f(u_i) = 2n+i-5, 1 \leq i \leq n$, Therefore, $f(u_n) = 3n-5$.

Hence, $ramn^{Dd}(Sf_n) \leq 3n-5$ …………(1)

Since Sf_n has 2n+1 vertices it requires 2n+1 distinct labels. Also by the radio analytic mean Dd-distance condition n-6 labels between 1 and n are forbidden.

$$ramn^{Dd}(Sf_n) \geq (2n+1) + n - 6$$

$$\geq 3n-5 \ldots\ldots\ldots(2)$$

From (1) and (2)

Hence, $ramn^{Dd}(Sf_n) = 3n-5 \; n \geq 7$.

Note: $ramn^{Dd}(Sf_n) = 2n+, if\ n = 3,4,5,6$.

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2. CONCULSION

In this paper we studied the Radio analytic mean Dd-distance graphs, which involves Dd-distance and diameter. We computed the Radio analytic mean Dd-distance number by using in some Modern graphs and radio analytic mean number depends on the distance constraints.

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