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Game Theoretic Power Allocation for Coexisting Multistatic Radar and Communication Systems

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***Abstract*—In this paper, a non-cooperative game theoretic power allocation (NGTPA) scheme is proposed for coexisting multistatic radar and wireless communication systems. Due to the fact that each radar in the system is selfish-interested to maximize its own utility, we utilize the non-cooperative game theory to tackle the power allocation problem. The main objective of the multistatic radar is to minimize the power consumption of each radar by optimizing the transmission power allocation, which are constrained by a predefined signal-to-interference-plus-noise ratio (SINR) requirement for target detection and a maximum acceptable interference power threshold for communication system. First, taking into consideration the target detection performance and received interference power at the communication receiver, a novel utility function is defined and adopted as the optimization criterion for the NGTPA strategy. Then, the existence and uniqueness of the Nash equilibrium (NE) point are analytically proved. Furthermore, an iterative power allocation algorithm is developed that converges quickly to the NE of the non-cooperative game model. Numerical simulations are provided to demonstrate the superior performance of the proposed NGTPA algorithm.**

***Keywords*—Game theory, power allocation, multistatic radar, spectral coexistence.**

I. Introduction

With the rapid developments in large bandwidth wireless networks and precise synchronization techniques, the deployment of multistatic radar system has become feasible and is on a path from theory to practical use [1][2]. It has been demonstrated that multistatic radar system with multiple separated transmitters and receivers has a number of advantages over monostatic radar due to its spatial and waveform diversities [3][4].

Recently, game theory has been extensively developed within the radar research community to optimize various radar resources. To be specific, the authors in [5] model the interaction between a smart target and a smart multiple-input multiple-output (MIMO) radar as a two-person zero-sum game. In [6], Bacci et al. develop a game theory based distributed algorithm for radar network, which optimally allocates the transmission power to each radar while improving the target detection performance in terms of probabilities of detection and false alarm. In [7], a non-cooperative game theory based power allocation approach is proposed for a multistatic MIMO radar network, whose objective is to minimize the total power consumption while maintaining a desired target detection requirement. Deligiannis et al. in [8] investigate the competitive power allocation game between a radar network and multiple jammers. Further, they revisit the power allocation problem of a multistatic MIMO radar network [1], which is formulated as a generalized Nash game. The objective of the radar network is to minimize the total transmission power while satisfying a given target detection criterion. However, the radio frequency (RF) spectrum scarcity has become a very essential and changing problem, which is owing to the services with high bandwidth requirements and rapid growing of mobile telecommunications [9]. One of the feasible solutions is to improve spectrum efficiency by employing the potential of existing spectrum [10]. While these early works do not consider the spectrum sharing between multistatic radar and communication systems, and the harmful interference to the communication system which is generated by the radars is ignored. In particular, the authors in [9] propose the idea that the problem of radar and long term evolution (LTE) systems coexistence may be solved by employing non-cooperative game. In this study, we will extend the results in [1][9] and the problem we will address is how to optimize transmit power allocation for coexisting multistatic radar and wireless communication system. Part of the results presented in this study also appears in [11].

The major contributions of this paper are threefold:

(1) The problem of non-cooperative game theoretic power allocation (NGTPA) for coexisting multistatic radar and communication systems is studied, whose objective is to minimize the transmit power of each radar subject to a desired SINR requirement for target detection and a maximum acceptable interference power threshold for communication system.

(2) Taking into consideration the transmission power of each radar, the specified SINR threshold and the maximum acceptable interference power at the communication receiver, a novel utility function is defined and adopted as the optimization criterion for the NGTPA strategy.

(3) The existence and uniqueness of the NGTPA model's Nash equilibrium (NE) is analytically proven. Moreover, an iterative and distributed power allocation algorithm with low complexity and fast convergence is developed.

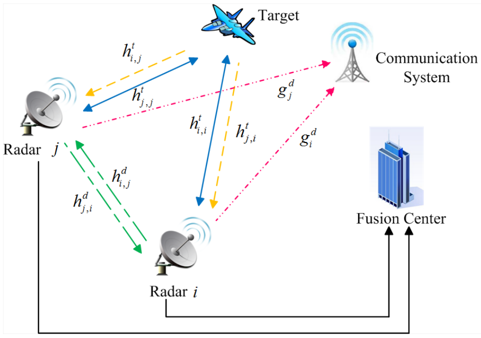

Fig. 1. Coexisting multistatic radar and communication systems model.

II. System Model

We consider a scenario, where a multistatic radar system consisting of N_t radars coexists with a communication system in the same frequency band, as depicted in Fig.1. The ith radar receives the echoes from the target due to its transmitted signals as well as the signals from the other radars, both scattered off the target and through a direct path. The waveforms emitted from different radars may not be orthogonal because of various reasons, which could induce considerable mutual interference. It is assumed that successive interference cancellation (SIC) technique is employed at each radar receiver to remove both direct and target scattered communication signals from the observed signal [12]. At the communication system, it is also supposed that the radar transmitted signal scattered off the target is much weaker than that coming through the direct path from the radar transmitter, which is ignored for simplicity.

In the considered non-cooperative game theoretic framework, each radar performs the power minimization autonomously and sends its received target signals to the fusion center. The propagation gains of corresponding paths are defined as follows:

$$\begin{cases} h_{i,i}^t = \dfrac{G_t G_r \sigma_{i,i}^{\text{RCS}} \lambda^2}{(4\pi)^3 R_i^4}, h_{i,j}^t = \dfrac{G_t G_r \sigma_{i,j}^{\text{RCS}} \lambda^2}{(4\pi)^3 R_i^2 R_j^2}, \\ h_{i,j}^d = \dfrac{G_t^{'} G_r^{'} \lambda^2}{(4\pi)^2 d_{i,j}^2}, g_i^d = \dfrac{G_t^{'} G_c \lambda^2}{(4\pi)^2 d_i^2}, \end{cases} \tag{1}$$

where $h_{i,i}^t$ represents the propagation gain for the radar i-target-radar i path, $h_{i,j}^t$ represents the propagation gain for the radar i-target-radar j path, $h_{i,j}^d$ represents the direct radar i-radar j path, g_i^d represents the direct radar i-communication system path. G_t is the radar main-lobe transmitting antenna gain, G_r is the radar main-lobe receiving antenna gain, $G_t^{'}$ is the radar side-lobe transmitting antenna gain, $G_r^{'}$ is the radar side-lobe receiving antenna gain, and G_c is the communication receiving antenna gain. $\sigma_{i,i}^{\text{RCS}}$ is the RCS of the target with respect to the ith radar, $\sigma_{i,j}^{\text{RCS}}$ is the RCS of the target from radar i to radar j, λ denotes the wavelength, R_i denotes the distance from radar i to the target, R_j denotes the distance from radar j to the target, $d_{i,j}$ denotes the distance between radar i and radar j, d_i denotes the distance between radar i and communication system.

The generalized likelihood ratio test (GLRT) is used to determine the appropriate detector [1][7]. The probabilities of detection $p_{\text{D},i}(\delta_i, \gamma_i)$ and false alarm $p_{\text{FA},i}(\delta_i)$ are:

$$\begin{cases} p_{\text{D},i}(\delta_i, \gamma_i) = \left(1 + \dfrac{\delta_i}{1-\delta_i} \cdot \dfrac{1}{1+N\gamma_i}\right)^{1-N}, \\ p_{\text{FA},i}(\delta_i) = (1-\delta_i)^{N-1}, \end{cases} \tag{2}$$

where δ_i is the detection threshold, N is the number of received pulses in the time-on-target. γ_i denotes the SINR received at the ith radar, which can be given by:

$$\gamma_i = \frac{h_{i,i}^t P_i}{\sum_{j=1, j\neq i}^{N_t} c_{i,j}\left(h_{i,j}^d P_j + h_{i,j}^t P_j\right) + \sigma_w^2} = \frac{h_{i,i}^t P_i}{I_{-i}}, \tag{3}$$

where P_i denotes the transmission power of radar i, σ_w^2 denotes the environment noise power, $I_{-i} = \sum_{j=1, j\neq i}^{N_t} c_{i,j}\left(h_{i,j}^d P_j + h_{i,j}^t P_j\right) + \sigma_w^2$ denotes the total interference and noise received at the ith radar.

III. Game Theoretic Formulation

A. Game Theoretic Model

The characteristics of the interaction of the players in the non-cooperative power allocation game in strategic form is:

$$\mathcal{G} = \left[\mathcal{N}, \{\mathcal{P}_i\}_{i\in\mathcal{N}}, \{U_i\}_{i\in\mathcal{N}}\right], \tag{4}$$

where $\mathcal{N} = \{1, \cdots, N_t\}$ denotes the finite set of players, $\mathcal{P}_i$ denotes the ith player's strategy space, where $\mathcal{P}_i = [0, P_i^{\max}]$, and U_i denotes the player's utility function. The strategy space of the NGTPA model $\mathcal{P} = \mathcal{P}_1 \times \mathcal{P}_2 \times \cdots \times \mathcal{P}_{N_t}$, where the subscript $-i$ represents all players except player i.

Utility function is the foundation of game theory, which will deduce the iterative algorithm. Thus, it is very important to select an ideal utility function when utilizing non-cooperative game theory. For spectrum sharing between multiple-radar system and communication system, the target detection performance and received interference power at the communication receiver should be taken into account, which should be reflected in the utility function. Here, the primary objective of the multistatic radar is to minimize the transmit power of each radar while guaranteeing a predefined SINR requirement for target detection and a maximum acceptable interference power threshold for communication system. Therefore, the utility function is defined as follows:

$$\begin{aligned} U_i(P_i, \mathbf{P}_{-i}) = \ln(\gamma_i - \gamma_{\min}) + \frac{a_i h_{i,i}^t}{g_i^d\left(T_{\max} - \sum_{j=1, j\neq i}^{N_t} g_j^d P_j\right)} \\ \times \sqrt{P_i^{\max} - P_i}, \end{aligned} \tag{5}$$

where $\mathbf{P}_{-i}$ is the power allocation adopted by all radars except radar i, $\gamma_{\min}$ is the desired SINR threshold, $T_{\max}$ denotes the maximum acceptable interference power, $P_i^{\max}$ denotes the maximum transmit power of radar i, and $a_i > 0$ denotes the constant weighting factor.

The goal of each player is to maximize its utility by selecting an appropriate strategy of transmission power. Therefore, consider a specified SINR requirement for target detection and a maximum acceptable interference power threshold for communication system, the NGTPA model can be formulated as follows:

$$\max_{P_i, i\in\mathcal{N}} \; U_i(P_i, \mathbf{P}_{-i}), \tag{6a}$$

$$\text{s.t.}: \quad \begin{cases} \gamma_i \geq \gamma_{\min}, i \in \mathcal{N}, \\ \sum_{i=1}^{N_t} g_i^d P_i \leq T_{\max}, \\ 0 \leq P_i \leq P_i^{\max}, i \in \mathcal{N}. \end{cases} \tag{6b}$$

The first constraint implies that the power allocation results should be no less than the predetermined SINR threshold $\gamma_{\min}$, while the second constraint stands that the total received interference power at the communication receiver cannot exceed the maximum acceptable interference threshold $T_{\max}$. The last constraint represents that the transmit power of each radar is constrained by a maximum value $P_i^{\max}$. It should be noted that the selection of weighting factor a_i is of high importance. Specifically, if $\gamma_i \leq \gamma_{\min}$, a_i remains unchanged; whereas if $\gamma_i > \gamma_{\min}$, we adjust the level of $a_i = a_i\left(\frac{\gamma_i}{\gamma_{\min}}\right)^2$ adaptively, which decreases the transmit power by increasing the punishment for player i.

B. Iterative Power Allocation Algorithm

The objective of a non-cooperative game is to find an NE point at which none of the players has the incentive to change its strategy. Subsequently, taking the first derivative of $U_i(P_i, \mathbf{P}_{-i})$ with respect to P_i, we have:

$$\begin{aligned}\frac{\partial U_i(P_i, \mathbf{P}_{-i})}{\partial P_i} &= \frac{1}{\gamma_i - \gamma_{\min}}\frac{h_{i,i}^t}{I_{-i}} - \frac{1}{\sqrt{P_i^{\max} - P_i}} \\ &\times \frac{a_i h_{i,i}^t}{2g_i^d\left(T_{\max} - \sum_{j=1, j\neq i}^{N_t} g_j^d P_j^{(n)}\right)},\end{aligned} \tag{7}$$

We set $\frac{\partial U_i(P_i, \mathbf{P}_{-i})}{\partial P_i} = 0$ and rearrange the terms. Then, we can obtain radar i's transmit power iteration function as:

$$\begin{aligned}P_i^{(n+1)} = &\left[\frac{P_i^{(n)}}{\gamma_i^{(n)}}\gamma_{\min} + \frac{2g_i^d\left(T_{\max} - \sum_{j=1, j\neq i}^{N_t} g_j^d P_j^{(n)}\right)}{a_i^{(n)} h_{i,i}^t}\right. \\ &\left.\times\sqrt{P_i^{\max} - P_i^{(n)}}\right]_0^{P_i^{\max}},\end{aligned} \tag{8}$$

where $[x]_a^b = \max\{\min(x, b), a\}$, n denotes the iteration index. The presented NGTPA strategy is executed by each radar in the system in a distributed manner so that the NE point of NGTPA model can be determined, whose pseudo-code is shown in Algorithm 1. Note that the propagation gains of corresponding paths need to be obtained to support computing and updating, which is the basis of the iterative algorithm.

C. Existence and Uniqueness

Theorem 1 (Existence): The proposed NGTPA model $\mathcal{G} = \{\mathcal{N}, \{\mathcal{P}_i\}_{i\in\mathcal{N}}, \{U_i\}_{i\in\mathcal{N}}\}$ has at least one NE.

Proof: At least one NE exists in the proposed NGTPA model $\mathcal{G} = \{\mathcal{N}, \{\mathcal{P}_i\}_{i\in\mathcal{N}}, \{U_i\}_{i\in\mathcal{N}}\}$. If for $\forall i \in \mathcal{N}$:

Algorithm 1 : NGTPA Strategy

1: **Initialization:** Set $n = 0$, $\gamma_{\min}$, $\varepsilon > 0$ (ε is a small positive constant); Select a random transmit power $P_i^{(n=0)}$ from space $\mathcal{P}$; Obtain the corresponding path gains.

2: **Repeat Until:** $\left|P_i^{(n+1)} - P_i^{(n)}\right| < \varepsilon$

  for $i = 1, \cdots, N_t$, **do**

    Calculate $P_i^{(n)}$ by solving (8);

    if $\gamma_i^{(n)} > \gamma_{\min}$

      $a_i^{(n+1)} \leftarrow a_i^{(n)}\left(\frac{\gamma_i^{(n)}}{\gamma_{\min}}\right)^2$;

    else

      $a_i^{(n+1)} \leftarrow a_i^{(n)}$;

    end if

  end for

  Set $n \leftarrow n + 1$;

3: **Update:** Update $P_i^* \leftarrow P_i^{(n)}$ for $\forall i$.

(a) The transmission power P_i is a non-empty, convex and compact subset of some Euclidean space.

(b) The utility function $U_i(P_i, \mathbf{P}_{-i})$ is continuous in power domain $\mathbf{P}$ and quasi-concave in P_i.

It is evident that our proposed NGTPA strategy satisfies Condition (a), which is because each radar's transmission power P_i ranges from 0 to $P_i^{\max}$.

One can notice from (5) that the utility functions $U_i(P_i, \mathbf{P}_{-i})(\forall i \in \mathcal{N})$ are continuous with respect to P_i. Now take the second order derivative of $U_i(P_i, \mathbf{P}_{-i})$ with respect to P_i, we can obtain:

$$\begin{aligned}\frac{\partial^2 U_i(P_i, \mathbf{P}_{-i})}{\partial P_i^2} &= -\frac{(h_{i,i}^t)^2}{I_{-i}^2(\gamma_i - \gamma_{\min})^2} - \frac{1}{\sqrt{(P_i^{\max} - P_i)^3}} \\ &\times \frac{a_i h_{i,i}^t}{4g_i^d\left(T_{\max} - \sum_{j=1, j\neq i}^{N_t} g_j^d P_j\right)} < 0.\end{aligned} \tag{9}$$

Therefore, $U_i(P_i, \mathbf{P}_{-i})$ is continuous and quasi-concave in P_i, which completes the existence proof of NE. ∎

Theorem 2 (Uniqueness): The NE of the proposed NGTPA model $\mathcal{G} = \{\mathcal{N}, \{S_i\}_{i\in\mathcal{N}}, \{U_i\}_{i\in\mathcal{N}}\}$ is unique.

Proof: Aiming at showing that the NE of the proposed game model $\mathcal{G}$ is unique, we have to prove that radar's best response strategy function:

$$\begin{aligned}f(P_i) = &\frac{P_i}{\gamma_i}\gamma_{\min} + \frac{2g_i^d\left(T_{\max} - \sum_{j=1, j\neq i}^{N_t} g_j^d P_j\right)}{a_i h_{i,i}^t} \\ &\times\sqrt{P_i^{\max} - P_i}\end{aligned} \tag{10}$$

should be standard, which satisfies the following conditions:

(a) *Positivity:* For $\forall i \in \mathcal{N}$, $f(P_i) > 0$.

(b) *Monotonicity:* If $P_i^1 > P_i^2$, $f(P_i^1) > f(P_i^2)$.

(c) *Scalability:* For all $\alpha > 1$, $\alpha f(P_i) > f(\alpha P_i)$.

For Condition (a), since $P_i \le P_i^{\max}$ and $\sum_{j=1,j\neq i}^{N_t} g_j^d P_j \le T_{\max}$, thus

$$f(P_i) = \frac{P_i}{\gamma_i}\gamma_{\min} + \frac{2g_i^d\left(T_{\max} - \sum_{j=1,j\neq i}^{N_t} g_j^d P_j\right)}{a_i h_{i,i}^t} \times \sqrt{P_i^{\max} - P_i} > 0. \tag{11}$$

and the positivity property is satisfied.

For Condition (b), if $P_i^1 > P_i^2$,

$$\begin{aligned} & f(P_i^1) - f(P_i^2) \\ & = \left[\frac{\gamma_{\min}}{\gamma_i}\left(\sqrt{P_i^{\max} - P_i^2} + \sqrt{P_i^{\max} - P_i^1}\right) \right. \\ & \left. + \frac{2g_i^d\left(T_{\max} - \sum_{j=1,j\neq i}^{N_t} g_j^d P_j\right)}{a_i h_{i,i}^t}\right] \\ & \times \left(\sqrt{P_i^{\max} - P_i^2} - \sqrt{P_i^{\max} - P_i^1}\right) \end{aligned}$$

Since

$$\begin{aligned} & P_i \le \frac{\left(T_{\max} - \sum_{j=1,j\neq i}^{N_t} g_j^d P_j\right)}{g_i^d} = \xi \\ & \Rightarrow \sqrt{P_i^{\max} - P_i^1} + \sqrt{P_i^{\max} - P_i^2} > 2\sqrt{P_i^{\max} - \xi}, \end{aligned} \tag{12}$$

thus,

$$f(P_i^1) - f(P_i^2) > 0. \tag{13}$$

and the monotonicity property is satisfied.

For Condition (c), $\forall i \in \mathcal{N}$,

$$\alpha f(P_i) - f(\alpha P_i) = \frac{2g_i^d\left(T_{\max} - \sum_{j=1,j\neq i}^{N_t} g_j^d P_j\right)}{a_i h_{i,i}^t} \times \left(\alpha\sqrt{P_i^{\max} - P_i} - \sqrt{P_i^{\max} - \alpha P_i}\right) \tag{14}$$

Owing to $\alpha > 1$, we can obtain:

$$\alpha\sqrt{P_i^{\max} - P_i} > \sqrt{P_i^{\max} - P_i} > \sqrt{P_i^{\max} - \alpha P_i}. \tag{15}$$

Thus,

$$\alpha f(P_i) - f(\alpha P_i) > 0. \tag{16}$$

and the scalability property is satisfied.

Therefore, the best response strategy function $f(P_i)$ is standard, and our proposed NGTPA model has only one unique Nash equilibrium solution, which completes the uniqueness proof of NE. ■

IV. Numerical Simulations

In this section, numerical examples and analysis are provided for the proposed NGTPA strategy. We consider a multistatic radar system with $N_t = 4$ radars. The positions of multiple radars are shown in Table.I, and the communication system is located at $[-10, 0]$km. To investigate the dependence of the power allocation strategy on the geometry between target and multistatic radar system, two different target locations with respect to the multiple-radar system are chosen. In the first case, it is supposed that the target is located at $[0, 0]$km. In the second case, we simulate a scenario where the target is located at $[-\frac{25}{\sqrt{2}}, \frac{25}{\sqrt{2}}]$km. The system parameters are set as follows: $G_t = G_r = 27$ dB, $G_t^{'} = G_r^{'} = -30$ dB, $G_c = 0$ dB, $\lambda = 0.10$ m, $P_i^{\max} = 1000$ W, $\sigma_w^2 = 10^{-18}$ W, $c_{i,j} = 0.01$, $N = 512$, $p_{\mathrm{FA}} = 10^{-6}$, $p_{\mathrm{D}} = 0.9973$, $\gamma_{\min} = 10$ dB, $T_{\max} = -105$ dBmW, $a_i = 10^{10}$. The target's RCS model is uniform reflectivity, i.e., $\sigma_{i,j}^{\mathrm{RCS}} = 1$ m$^2 (\forall i, j)$.

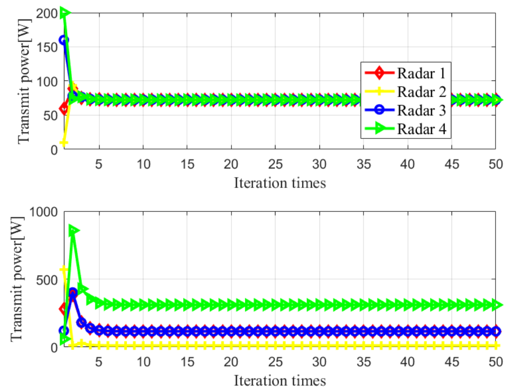

Fig. 2. Convergence of power allocation results: (a) Case 1, (b) Case 2.

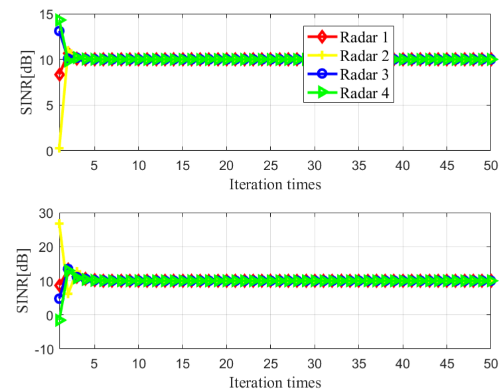

Fig. 3. Convergence of SINR: (a) Case 1, (b) Case 2.

TABLE I
Radars Positions in Multistatic Radar System

Radar	Position [km]	Radar	Position [km]
1	$\left[\frac{50}{\sqrt{2}}, \frac{50}{\sqrt{2}}\right]$	3	$\left[-\frac{50}{\sqrt{2}}, -\frac{50}{\sqrt{2}}\right]$
2	$\left[-\frac{50}{\sqrt{2}}, \frac{50}{\sqrt{2}}\right]$	4	$\left[\frac{50}{\sqrt{2}}, -\frac{50}{\sqrt{2}}\right]$

Fig.2 plots the transmission power allocation iterations of all the radars in the system for different initial power allocations, where the game is initialized with $\mathbf{P} = [60, 10, 160, 200]$W and $\mathbf{P} = [280, 570, 120, 60]$W, respectively. In Fig.3, the SINR convergence curves of the NGTPA strategy are depicted. One can observe from Fig.2 that the efficiency of the NGTPA

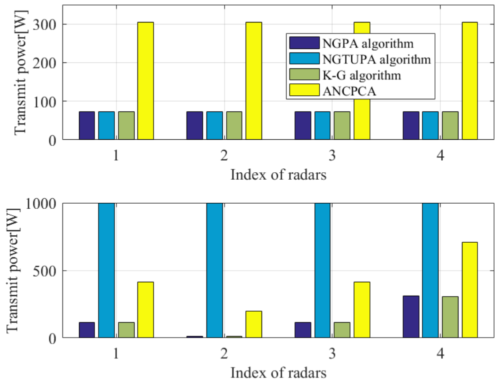

Fig. 4. Comparisons of equilibrium power consumption employing different algorithms: (a) Case 1, (b) Case 2.

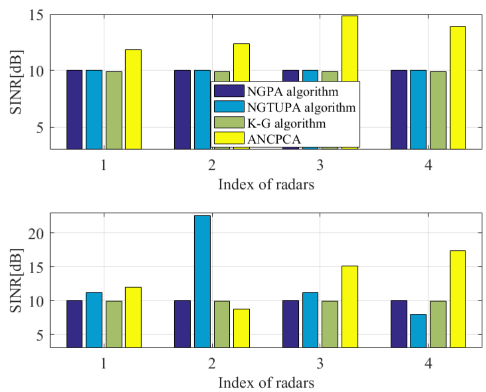

Fig. 5. Comparisons of equilibrium SINR employing different algorithms: (a) Case 1, (b) Case 2.

model is evident, which only needs about 9-12 iterations to reach the optimal power allocation strategy. The results highlight that regardless of the initial strategy of the players, the NGTPA model converges to the unique Nash equilibrium. Then, to show the importance of the relative geometry between the target and distributed multiple-radar architectures, we change the target position to $[-\frac{25}{\sqrt{2}}, \frac{25}{\sqrt{2}}]$km, and provide the power allocation update of all the radars in Fig.2 (b). In Fig.2 (b), less transmission power is assigned to Radar 1, Radar 2, and Radar 3, as they are closer to the target. That is to say, the radar farther from the target tends to be allocated more power.

In order to assess the efficiency of the presented power allocation algorithm, we compare the results of the proposed method with other three algorithms for power allocation: the uniform power allocation algorithm, the Koskie and Gajic's (K-G) algorithm in [13], and the adaptive non-cooperative power control algorithm (ANCPCA) in [14]. By imposing an additional constraint in the problem (6), which allocates uniformly the transmission power among the radars in the system, we can obtain the non-cooperative game theory based uniform power allocation (NGTUPA) algorithm. From Figs.4 & 5, it is worth to point out that the proposed NGTPA strategy not only minimizes the transmission power but also maintains the desired SINR threshold of each radar. It can be seen that the proposed NGTPA algorithm outperforms the NGTUPA algorithm in both cases, in terms of the power consumption and achieved target detection performance. Although the K-G method transmits the least power, the required target detection performance of all the radars cannot be met. In addition, the ANCPCA algorithm transmits the most power due to the radars' selfish behavior in the non-cooperative game, which is consistent with the results in [14]. Therefore, the results reveal the superiority of the proposed NGTPA strategy compared to other existing approaches.

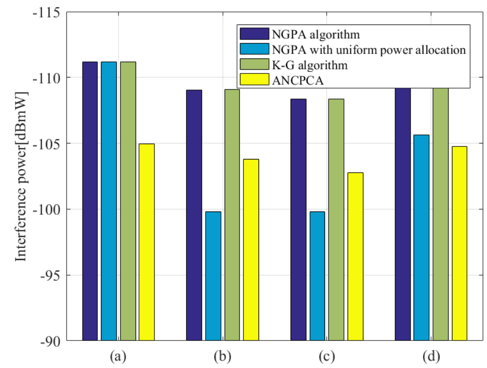

Fig. 6. Comparisons of interference power levels employing different algorithms: (a) Case 1, (b) Case 2.

Fig.6 illustrates the effects of the multistatic radar system on the coexisting communication system, which presents a histogram of the interference power level received at the communication system, comparing the four algorithms for the different cases. As we can observe, the interference power levels for the proposed strategy and K-G algorithm are much lower than the NGTUPA method and ANCPCA, which are below the maximum acceptable interference power threshold $T_{\max}$ for communication system in all scenarios. Thus, the QoS can be guaranteed by ensuring the multiple radars do not generate high interference to the communication system. However, the K-G algorithm is not ideal because the SINR requirement of each radar cannot be satisfied. Finally, it should be noted that the proposed NGTPA strategy outperforms other algorithms in terms of power saving, target detection, and spectrum coexistence performance between multistatic radar and communication system in the same frequency band.

V. Conclusion

This study investigates a NGTPA strategy for coexisting multistatic radar and wireless communication systems, whose objective is to minimize the transmit power of each radar by optimizing power allocation, which are constrained by a desired SINR requirement for target detection and a maximum acceptable interference power threshold for communication system. Then, the existence and uniqueness of the NE are proved analytically. In addition, an iterative power allocation algorithm is developed to play the game among different radars. Finally, numerical results demonstrate the existence and uniqueness of the Nash equilibrium, which show that the optimal power allocation strategy of a multistatic radar system is dependent on the geometry between target and multistatic radar configuration. It is worth to point out that the received interference power at the communication system is below the maximum acceptable interference power threshold in various scenarios. Future work will perform much more different simulation experiments to validate its effectiveness.

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