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Strategic Analysis of the Conflict Over Iran's Nuclear Program

Majid Sheikhmohammady, Keith W. Hipel, and Hossein Asilahijani
Department of Systems Design Engineering
University of Waterloo
Waterloo, Ontario, N2L 3G1, Canada
{msheikhm,kwhipel,hasilahi}@engmail.uwaterloo.ca

D. Marc Kilgour
Department of Mathematics
Wilfrid Laurier University
Waterloo, Ontario, N2L 3C5, Canada
mkilgour@wlu.ca

Abstract—**Formal analytical techniques are employed for better understanding the continuing conflict over Iran's nuclear program, including predicting various outcomes and recommending how to reduce the intensity of the conflict, or at least prevent its escalation. The Graph Model for Conflict Resolution is used to investigate the strategic interaction of Iran and its opponents. The analysis of our model shows that a military conflict is certainly possible but not the most likely outcome. We conclude with suggestions about how the decision makers could reach a peaceful resolution, demonstrating that the International Atomic Energy Agency should be as actively involved as possible.**

***Keywords*— Graph Model for Conflict Resolution, Iran, nuclear conflict, strategy, stability**

I. INTRODUCTION

One of the most significant controversies of the new millennium is the issue of Iran's nuclear programs. This continuing conflict has economic, political, and potentially military aspects that threaten the strategic balance in the Middle East, and thus has global implications. Our objective is to analyze Iran's decision-making.

After reviewing the background, we study Iran's choices in the multi-decision maker contexts. To gain insight into Iran's situation, we employ the Graph Model for Conflict Resolution to capture the interactive nature of this decision problem. In the conclusions, we formulate recommendations to improve the situations.

II. HISTORICAL BACKGROUND

Iran has had a nuclear program for close to 50 years, beginning with a research reactor purchased from the United States in 1959 [2]. On July 1, 1968, Iran signed the nuclear Non-Proliferation Treaty (NPT) which was ratified on March 5, 1970 [18].

In August 2002, a group of Iranian dissidents reported that Tehran had built a uranium enrichment plant at Natanz and a heavy water plant at Arak without informing the International Atomic Energy Agency (IAEA) [12]. This report was not denied by Iran, and in February 2003, President Khatami announced the construction of uranium enrichment facilities in Natanz. This disclosure turned the Iranian nuclear issue into a crisis. Mohammad ElBaradei, head of IAEA, who visited Iran with a team of inspectors, found traces of highly enriched uranium at Natanz, and urged Iran to sign the Additional Protocol to the NPT allowing more intrusive inspections. In October 2003, Tehran agreed to stop producing enriched uranium and to sign the Additional Protocol. One month later, Mr. ElBaradei reported that there was "no evidence" that Iran was pursuing nuclear weapons, but in June 2004 the IAEA reported that Iran was trying to import magnets for centrifuges and not offering "full, timely and pro-active" co-operation with inspectors, and ordered Iran to stop any large-scale enrichment [1]. The governments of the United Kingdom, France and Germany (called the EU-3) negotiated a temporary agreement in November 2004 to halt all enrichment activities [18]. Iran's parliament refused to ratify the Additional Protocol of NPT when the IAEA declared that Iran was in non-compliance with the NPT in 2005.

Like those of the EU-3, Chinese and Russian attempts to find a reasonable resolution also failed in the face of Iranian insistence on the right to enrich uranium [25], [15].

On September 15, 2005, at a United Nations summit, President Ahmadinejad asserted Iran's right to develop a civil nuclear-power program. In January 2006, Iran announced the resumption of its uranium enrichment program. The interval of study for this paper stretches from this event, until June 2008. During this period, all resolutions offered to Iran required the suspension of uranium enrichment, a precondition that Iran rejected [18].

In June 2006, the five permanent members of the United Nations Security Council plus Germany (G5+1) agreed on an incentive package to induce Iran to suspend enrichment, but Iran rejected the package. On December 23, 2006, the United Nations Security Council imposed sanctions on Iran for continuing its uranium enrichment program, mandating all UN member states "to prevent the supply, sale or transfer... of all items, materials, equipment, goods and technology which could contribute to Iran's enrichment-related, reprocessing or heavy water-related activities or to the development of nuclear weapon delivery systems" [21].

Meanwhile, the Parliament of Iran instructed the government to reduce its cooperation level with the IAEA [24]. In February 2007, the IAEA stated that it had no evidence that Iran had diverted any declared material, but that it could not confirm the absence of undeclared material. The

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UNSC tightened the sanctions on March 24, 2007 [20], placing further sanctions on Iran, including prohibiting the export of arms, and freezing the assets of organizations and individuals involved in Iran's nuclear and missile efforts. It also prohibited dealings with the state bank Sepah and numerous high-level persons and organizations. Still, Iran did not suspend its uranium enrichment program, and Iran's parliament threatened to force the government to withdraw if the stand-off was not resolved "peacefully" [11]. The situation continued through 2007 [19].

On March 3, 2008 the Security Council approved a new round of even tougher sanctions under Chapter VII, Article 41 of the UN Charter, which obliges states to implement them for economic measures, but not the use of military force [22]. In summary, Iran was required by the Security Council and the IAEA to stop all enrichment and related activities. The IAEA also called on Iran to ratify and implement the Additional Protocol of NPT, in order to establish confidence. The standoff is the focus of our analysis.

III. Strategic Analysis

We now employ the Graph Model for Conflict Resolution [3], [14], to investigate the strategic interaction of Iran and its opponents. In a graph model, a state represents a potential outcome or scenario of the conflict. Each decision maker's (DM's) possible choices are described using a directed graph in which nodes represent states and arcs indicate state transitions controlled by the DM. The Graph Model for Conflict Resolution can provide understanding, insights, and guidance regarding a specific conflict.

The decision support system GMCR II [4], [5], [7], [8], is used to apply the graph model methodology to the modeling and analysis of the Iran nuclear conflict. To use GMCR II, the DMs in the conflict, their options, and their preferences must first be entered. The following section describes these steps for the case of the Iranian conflict.

Decision Makers and Options

Before January 2006, the US, Russia, China, the EU-3, the IAEA, and Iran were the key decision makers. However, this model is developed for the situation which existed after the resumption of uranium enrichment by Iran in January 2006. Because the US, Russia, China and the EU-3 tried to unify their approach and express their objectives following the United Nations Security Council (UNSC) resolutions, we consider them as a single DM called UNSC [24], [15], [25]. Hence, the three DMs in this model are UNSC, IAEA and Iran.

The United Nations Security Council (UNSC)

The UNSC is the branch of the United Nations charged with the maintenance of international peace and security. Its powers include organization of peacekeeping operations, establishment of international sanctions regimes, and authorization of military action. The Security Council consists of five permanent members, who have veto power over any resolution, and ten temporary members, who are elected for two-year terms by the United Nations General Assembly [23]. The UNSC's options are as follows:

1. Tighten the sanctions by adopting a new resolution (New Resolution).
2. Take military action against Iran (Military Action).
3. Close Iran's nuclear dossier and return it to IAEA (Close Dossier).

The International Atomic Energy Agency (IAEA)

The IAEA was established in 1957 to promote the peaceful use of nuclear energy, seeking to facilitate the domestic generation of nuclear energy and to restrict its use for non-military purposes only. Thus, IAEA has three main functions: inspecting existing nuclear facilities, reviewing information and standards, and promoting the scientific study of peaceful nuclear technology [10]. After the IAEA's Board of Governors voted to report Iran to the UNSC in February 2006, the IAEA continued to negotiate with Iran, hoping to reach an agreement about its nuclear program [10]. The IAEA had two major options:

1. Reach an agreement with Iran and recommend that UNSC close Iran's dossier (Agreement).
2. Support the complete suspension of Iran's uranium enrichment program (Support Resolution).

Iran

Iran's major decision is whether to cooperate with or defy the IAEA, and through it the UNSC and the Western powers. This can be expressed as three main options for Iran.

1. Cooperate with IAEA and clearly answer all IAEA's questions (Cooperation).
2. Temporarily suspend all uranium enrichment activities and open dialogue with the West (Suspension).
3. Insist on enrichment program, leave the NPT and risk escalation of the conflict to warfare (Escalation).

Feasible States

In total, there are eight options, so there are 2^8 combinations, or potential states, since each option can be either selected or not. However, many combinations of options cannot occur in practice and must be removed [6], [3]. In GMCR II, these infeasible states are eliminated by using option constraints [7], [8]. Each constraint is now briefly described.

- Mutually exclusive: A set of options from which at most only one may be selected. For example, the UNSC cannot both close Iran's dossier and take military action.
- At least one: A set of specified options from which at least one must be selected. For example, in our model the IAEA will select at least one option from the two under its control.
- Necessary conditions: A condition for selection, or not, of one or more options. For instance, UNSC will not take military action if Iran suspends uranium enrichment.

After all infeasible combinations are removed, only fifteen states remain as listed in Table 1.

Table 1. Feasible states of the conflict

UNSC															
New Resolution	N	Y	N	N	Y	N	Y	N	N	N	Y	Y	Y	Y	Y
Military Action	N	N	N	N	N	N	N	N	N	N	N	N	Y	N	Y
Close Dossier	N	N	Y	N	N	Y	N	N	Y	N	N	Y	N	N	N
IAEA															
Agreement	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	N
Support Resolution	N	N	N	N	N	N	Y	N	N	N	N	N	N	Y	Y
IRAN															
Cooperation	Y	Y	Y	N	N	N	N	Y	Y	N	N	N	N	N	N
Suspension	N	N	N	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N
Escalation	N	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y
State labels	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Each state or column in this table represents a possible scenario of the conflict. State 1, for example, indicates the current situation (summer, 2008) in which Iran cooperates with the IAEA, but does not suspend uranium enrichment or escalate the conflict, IAEA reaches an agreement with Iran, UNSC has not selected. Table 2 illustrates all possible unilateral movements for each DM. For example, UNSC can move from state 10 to state 13 unilaterally. Notice from Table 1 that this is indeed a unilateral move by UNSC because the option choices by the other two DMs are the same at both states. When moving from state 10 to 13, UNSC adopts a new resolution and unilaterally takes military action.

Table 2. Possible unilateral moves

State	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1		SC	SC	Iran				Iran	Iran	Iran					
2	SC		SC		Iran						Iran				
3	SC	SC				Iran			Iran						
4	Iran				SC	SC		Iran		Iran					
5		Iran		SC		SC	IAEA				Iran				
6			Iran	SC	SC				Iran						
7					IAEA									Iran	
8	Iran			Iran					SC	Iran					
9	Iran		Iran			Iran		SC							
10	Iran			Iran				Iran			SC	SC	SC		
11		Iran			Iran					SC		SC	SC	IAEA	
12										SC	SC		SC		
13										SC	SC	SC			IAEA
14							Iran				IAEA				
15													IAEA		

* Moves are from row state to column state.

DMs' Preference Rankings over the States

From the background discussed above, some conclusions about the DMs' preferences over the states can be inferred. Table 3 represents the ordering of states for each of the 3 DMs from most preferred on the left to least preferred on the right. For instance, state 8 is the most preferred and state 10 is the least preferred for UNSC.

Table 3. Decision makers' preferences over feasible states

Decision Maker	Most Preferred														Least Preferred
UNSC	8	9	7	5	4	6	2	1	14	11	15	13	3	12	10
IAEA	9	8	1	3	2	6	5	4	7	14	15	11	10	13	12
Iran	3	10	1	2	11	14	12	13	15	6	9	4	8	7	5

UNSC's Preferences

The UNSC is deeply suspicious of Iran's motives, so even if Iran answers all of IAEA's questions and addresses all of its concerns, closing the dossier is not preferred by UNSC without clear evidence of suspension. On the other hand, military action is not preferred. State ranking for UNSC is based upon the following statements, from most to least important.

1. UNSC prefers that Iran suspend all enrichment activities and cooperate with the IAEA with no aggressive actions.
2. If Iran does not cooperate, the UNSC prefers a new resolution that tightens the sanctions.
3. Only if a new resolution does not change Iran's behavior, would military action be acceptable.
4. UNSC will close the Iran dossier if and only if it is clear that Iran has suspended uranium enrichment.

IAEA's Preferences

IAEA prefers the states that represent cooperation because these states demonstrate its ability to positively influence a potentially dangerous situation. For this reason, the IAEA prefers the states in which Iran cooperates but does not suspend uranium enrichment to the states in which Iran does not cooperate but suspends uranium enrichment. Since this assumption may be debatable, it will be addressed later in a sensitivity analysis.

Iran's Preferences

Ayatollah Khamenei has the final word in Iran's foreign policy. On March 21, 2007, after mentioning Iran's cooperation with the IAEA and claiming that Iran's nuclear program was lawful, he said: "However, if they intend to exploit the UN Security Council and take illegal actions, we can and will act similarly" [13].

The message is quite clear. If the Western powers deny Iran what it perceives as its right, then Iran will expel IAEA inspectors, shut down monitoring devices, and go beyond peaceful enrichment in contravention of the NPT. Thus, states including escalating the conflict to war are not Iran's least preferred states. If Iran cannot reach an agreement with the IAEA (its preferred outcome) Iran prefers to insist on its enrichment right. Hence, the following preference statements describe Iran's key preferences underlying its ranking of states in Table 3:

1. The most preferred state for Iran is the situation in which Iran cooperates with the IAEA but does not suspends its uranium enrichment, and UNSC closes its dossier, and does not adopt a new resolution.
2. If a new resolution is adopted or military action is prescribed by UNSC, Iran prefers to leave the NPT and escalate the conflict.
3. States including suspension of uranium enrichment are least preferred by Iran.

Stability Analysis

A stable state is a state from which a DM has no incentive to move. An equilibrium is a state that is stable for all DMs. The stability of states for DMs is defined by various solution concepts, or stability definitions. Nash stability reflects a DM who thinks only one step ahead [16], [17]. In general metarationality (GMR) [9], and sequential stability (SEQ) [6], a DM considers exactly two steps ahead; whereas in symmetric metarationality (SMR) [9], the DM takes into account three steps by assessing available escapes from sanctions that may be imposed by the opponents. More far-sighted solution concepts include limited move and nonmyopic [3]. Since different stability definitions may be appropriate for different DMs, states that are stable under many definitions are considered to be firm. Consideration of more solution concepts for each DM ensures robust predictions.

Table 4 lists the equilibria under all of the solution concepts, using the software GMCR II. States 2, 14 and 15 are strong equilibria of the model. State 1, the status quo, is an equilibrium under GMR and SMR only. Since these two solution concepts apply when DMs do not know others' preferences, they may not induce a strong equilibrium. Hence, state 1 is unlikely to endure.

Table 4. Equilibria

UNSC			
New Resolution	Y	Y	Y
Military Action	N	N	Y
Close Dossier	N	N	N
IAEA			
Agreement	Y	N	N
Support Resolution	N	Y	Y
IRAN			
Cooperation	Y	N	N
Suspension	N	N	N
Escalation	N	Y	Y
State labels	2	14	15

Since all DMs in the model prefer state 2 to state 14 and state 14 to state 15, we predict state 2 as the most likely outcome. At state 2, despite Iran's agreement with IAEA and IAEA's report over Iran's satisfactory cooperation, the UNSC tightens its sanctions by adopting a new resolution. If Iran does not suspend uranium enrichment, cooperation with IAEA does not deter UNSC from adopting a new resolution, which may have severe economic and even security consequences. Figure 2 illustrates how the conflict may evolve from the current situation to the most likely equilibrium. As can be seen in this figure, UNSC can unilaterally cause the status quo state to change to state 2, by adopting a new resolution.

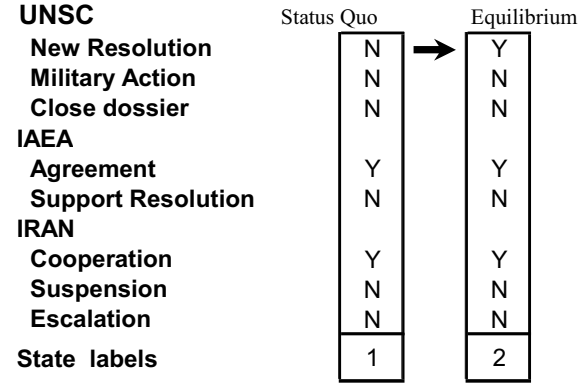

Figure 2. Possible evolution of the conflict

States 14 and 15 (see Table 1) represent the situation in which Iran neither cooperates with IAEA nor suspends her uranium enrichment activities, but decides to escalate by following through with leaving the NPT, operating a uranium enrichment program or even escalating the conflict to war. In these states, the IAEA supports a new resolution and the UNSC subsequently adopts it. The only difference between these two states is that UNSC takes military action in state 15. Since state 2 is readily accessible from the status quo and preferable to the other equilibria, we see those other equilibria as unlikely outcomes.

Sensitivity Analysis

In a conflict study, a sensitivity analysis often reflects uncertainty about one or more DMs' preferences. Hence, a reasonable range of preference changes should be analyzed to ascertain how the equilibria of the conflict are affected.

Sensitivity Analysis 1: In Iran there is debate about the importance of uranium enrichment and the likely cost of war. Most moderate and reformist parties in Iran believe that Iran should actively participate in negotiations and compromise, so as to avoid a military conflict. We address this view in the first sensitivity analysis, in which states 12, 13 and 15 including military action, are least preferred, leading to the following revised preference ranking:

Table 5. Revised preference ranking for Iran

Decision Maker	Most Preferred														Least Preferred
Iran	3	10	1	2	11	14	6	9	4	8	7	5	12	13	15

In addition to states 2, 14 and 15, a new equilibrium appears, given that the preferences of UNSC and the IAEA do not change. Specifically, state 7 is a weak equilibrium, according to two solution concepts, GMR and SMR. At this state, Iran does not cooperate with the IAEA but suspends uranium enrichment, IAEA supports a new resolution and UNSC adopts the new resolution.

Sensitivity Analysis 2: We now assume that IAEA prefers states in which Iran does not cooperate with the IAEA but suspends uranium enrichment to states in which Iran cooperates with the IAEA but does not suspend uranium enrichment. Then the ranking for IAEA will be as follows:

Table 6. Revised preference ranking for the IAEA

Decision Maker	Most Preferred														Least Preferred
IAEA	9	8	6	5	4	7	1	3	2	14	15	11	10	13	12

The equilibria do not change under this new ordering of states for the IAEA; states 2, 14, and 15 remain the only equilibria for the conflict.

Sensitivity Analysis 3: To assess the IAEA's role in the conflict, we assume that IAEA is neutral, interpreted as indifferent over all states. Under this situation, states 11 and 13 appear as new equilibria, while all previous equilibria (2, 14, and 15) remain. These new equilibria do not represent peaceful resolutions for the conflict, as they include escalation, a new resolution and even military action. This finding indicates that the IAEA plays an important role in reducing the possibility of military conflict.

IV. Conclusions and Recommendations

The conflict over Iran's nuclear program is modeled and analyzed using the Graph Model for Conflict Resolution. Based upon the results, we predict that Iran will not suspend uranium enrichment and that UNSC will tighten sanctions by adopting a new resolution, even if Iran cooperates with IAEA. Two of the three main equilibria of this model indicate that Iran will insist on its enrichment program, leave the NPT and accept the risk of escalation. Therefore, UNSC's treatment will determine whether Iran leaves the NPT, a disaster that all parties should seek to avoid through diplomacy.

IAEA is helping to avoid a military result, and should be actively involved in the conflict. The technical and professional nature of this international organization can reduce the tensions between Iran and UNSC, which is motivated mainly by the political interests of the Western powers.

In conclusion, a peaceful resolution to this conflict appears to be possible only if both Iran and the UNSC alter their perceptions. In other words, Iran should consider that military action is a serious option for UNSC and take UNSC resolutions seriously, while UNSC should understand that Iran may risk war if military action occurs.

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