A Narratological Approach for Narrative Discourse: Implementation and Evaluation of the System based on Genette and Jauss

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Abstract

This paper proposes a computational system of narrative discourse generation and its implementation. In the system, Genette's discourse theory is reconstructed as discourse techniques which transform the tree structure for a story into discourse structures. Also, we introduce Jauss's reception theory to construct the control mechanism, which continues discourse generation through generation cycles based on the interaction between both narrator and narratee mechanisms. Moreover, we attempt two kinds of performance checks and two types of evaluation experiments and confirmed that the system generates diverse discourse structures on the rough correspondence with generative parameters. And furthermore, this study show that two different types of literary knowledge are organically integrated into a system's framework.

Keywords: Narrative generation system; narrative discourse; story; narratology; Genette; Jauss.

Introduction

The research of narrative generation system is a challenging theme in artificial intelligence and cognitive science. It has a close relationship to various topics such as problem solving, planning, schema, story grammar, natural language generation, creativity, etc. Moreover, in recent years, interdisciplinary approaches with narratology and literary theories are also emerging. We have proceeded on a narrative generation system based on this kind of mixed approach since early 1990s. A common framework for the narrative generation system (Ogata, 1994; Ogata & Kanai, 2010; Akimoto & Ogata, 2011) consists of three stages: story, discourse, and surface representations (by language, animated movie, and music). Story is the content or a temporal sequence of events to be narrated, and discourse means how to organize a story or a narrated structure of events. They are generated as the conceptual representation forms or deep structures of narrative. Therefore, discourse phase does not equal natural language generation phase. The discourse in this paper especially means the internal structure of narrative representation. For example, many of the objectives treated by Callaway and Lester (2002) belong in natural language generation phase in the architecture of our narrative generation system. This paper deals with the part of discourse and proposes a computational model of structural narrative discourse processing and its implementation. As a fundamental standpoint, we use the discourse theory of Genette (1972). In addition, reception theory of Jauss (1970) is introduced into the system to control the generation and transformation of narrative discourse structure. First, this paper introduces the system architecture. And second, we present results of the system's evaluations, which focuses on the correctness of structure transformation and the control mechanism based on the interaction between narrator and narrate inside the system. Last, the problems and future directions are discussed.

In the area of researches on narrative generation system, there is no attempt that utilizes Jauss's reception theory. Moreover, most of previous systems (e.g., TALE-SPIN by Meehan (1980), BRUTUS by Bringsjord and Ferrucci (2000), and so on) focused on the aspect of "story" generation mainly. However, recently, Montfort (2007) applied Genette's discourse theory to develop an interactive fiction system, and Lönneker-Rodman (2005) introduced the category of "voice" in Genette theory into the conceptual design of natural language generation system. As stated above, the computational application of Jauss provides an original design which can be not comparable in other narrative generation systems. And, the introduction of Genette has the character based on systematic and comprehensive design more than the other attempts. Such introduction of the knowledge in literary area contributes to narrative generation system and artificial intelligence regarding the providing of more precise and pragmatic domain specific knowledge and can guide the exploration for the developing computational techniques in creative areas. Especially, we show that two different and separate narratologies are organically integrated into one computational mechanism. This is a worthy contribution that the introduction of narratology into computational simulation has.

Genette's Narrative Discourse Theory

Gérard Genette (1930-, France) is a representative literary theorist and narratologist mainly associated with structuralism. The discourse theory by Genette (1972) comparatively clearly categorizes various types of discourse techniques through the analysis of a novel. The theory consists of following three broad categories: "tense" relevant to the relationship between story's time and discourse's time, "mood" relevant to the modality for regulating narrative information, and "voice" relevant to the relationship among narrating, story and discourse. Each category is further divided into many subcategories. In the proposed system, discourse techniques are mainly relating to both categories for tense and mood.

Jauss's Reception Theory

Reception theory is one standpoint in modern literary theories and narratology, which focuses on the reception or reading process of literary works. In this theory, readers contribute strongly to the production process of literary works as a whole. Hans Robert Jauss (1921-1997, German) is a representative theorist of this area by proposing an idea to characterize literary history based on the concept of "horizon of expectation", which means a kind of previous knowledge for positioning a new work on the context of readers' experiences of reading. Artistic character of a new work is grasped by the disparity between the given horizon and the work, and the appearance of a new work may result in the change of an old horizon. We grasp this theory as a model which literary works are continuously changing through the interaction between authors and readers.

Proposing a Narrative Discourse Mechanism

We propose a narrative discourse system using both ideas of Genette and Jauss. This system is intended to be positioned in the part of narrative discourse in the common framework for the narrative generation system (Ogata, 1994; Ogata & Kanai, 2010; Akimoto & Ogata, 2011). In the proposed discourse system, each category in Genette theory is elaborately formalized as a discourse technique for transforming a story structure or the part into a discourse structure, and Jauss theory is simply interpreted as a mechanism in which above discourse construction process is controlled through the interaction between narrator mechanism with generative parameters and narratee mechanism with expectation parameters.

These narrator and narratee do not mean real existences but virtual agents inside the system. In the current implementation, both narrator and narratee is individual model. However, reception theory covers both individual model and collective one, and we should consider other possibilities about the concepts in the future. For example, there are multiple models such as the narrator as an individual & the narratees as multiple individuals, and the narrators as multiple individuals & the narratee(s) as a collection. Our narrative generation research is an exploratory approach through the incremental revision of a variety of elements or modules and the integration and a flexible framework for the step-by-step expansion and conversion is prepared.

Following cycle continues according to the interaction of narrator and narratee. The narrator mechanism performs the processing of discourse generation and transformation using discourse techniques and a set of rules for controlling the application based on generative parameters. On the other hand, the narratee mechanism evaluates the result based on the comparison of expectation parameters and generative ones. In the next cycle, referencing the narratee's evaluation, the narrator tries to do the generation in an effort to come close to the narratee's expectation or higher degree of the satisfaction. However, the processing eventually comes at a point where the narratee's satisfaction turns to fall from rise or the narratee gets tired. In such timing, the narrator abandons a part of old generative parameters ("deviation") and moves to a new cycle of discourse generation according to a new strategy, and narratee's expectation is also altered.

As this process is a principled and elaborate computational application based on the idea and concept of reception theory, it is characterized as a comprehensive and general control mechanism for narrative generation system to be able to be expanded to other narrative generation stages such as story generation and natural language generation.

Structural Representations for Story and Discourse

Both structures for a story and a discourse have a same tree form. In the story tree, each leaf node is corresponding to an event described with conceptual representation, which is really described by a case frame consisting of one verb concept and eight kinds of cases such as agent and object. Each internal node in the story tree is corresponding to a "relation" combining with the child nodes like "cause-effect" and "serial". On the other hand, a discourse is described as a tree structure transformed from a story tree. And next seven kinds of relations are used for only the discourse tree: "recall", "present-backward", "prophecy", "present-feature", "episode", "description", and "repetition_discourse".

Discourse Techniques

In computational perspective, since each technique for discourse by Genette is respectively corresponding to a type of discourse structure outputted from an input story, the process is be able to define with a kind of transformation procedure. For the procedural definition of techniques, we prepare next five kinds of procedural primitives for operating any intermediate or terminal node in the input structure: deletion, copy, conjunction, substitution, and creation. Current version of the system has 13 kinds of discourse techniques using the primitives as shown in Table 1. Although techniques for tense cover the main part, a few techniques for mood are also contained. Figure 1 shows the operation of "complementary analepsis_ellipsis" as an example of transformation.

Control Mechanism

By reference to the comparatively vague description about effects of discourse techniques by Genette (1972), we originally defined discourse parameters including p_1:supplement, p_2:complexity, p_3:suspense, p_4:length, p_5:hiding, p_6:descripttiveness, p_7:repetition, p_8:diffuseness, p_9:implication, and p_{10}:temporal-independency. These parameters are associated with the feature and the effect of constructed discourse structures, and are used for generative goals for narrator and expectations for narratee. Each parameter takes the value of 1 (small), 2 (medium), or 3 (large). Moreover, we defined quantitative criteria for measuring the degree of attainment of each parameter in a generated discourse. These criteria are not based on the cognitive effects for recipient, but structural features which can be calculated from the number and order of specific leaf/internal nodes in the tree structure of discourse. For example, "length" is measured by the total number of leaf nodes in a discourse structure. The quantitative criteria are used for the system's evaluation experiments in the following section. And also, as mentioned later, the narrator decides discourse techniques to be applied based on the rules for selecting techniques by values of the generative parameters. These rules are defined according to the correlation coefficient between each generative parameter and each measured value using the above criteria.

Figure 2 shows the overview of control mechanism. The list of Table 2 is the explanation of important terms used in the process. For the process, an input story is given by user or previous story phase. Other necessary data are the saturation point in the degree of satisfaction (n_p, 1 or more), the number of generation cycles (1 or more), and some kinds of initial values including generative parameters, expectation parameters, the degree of desire in narratee (0 or more), and the number of sufficiency in narratee (0 or more). According to the input data, system repeats following five steps.

(1) Selection of Techniques Narrator decides techniques to be applied according to generative parameters and rules for selecting techniques to be used. These rules define 0 or more techniques corresponding to each parameter's value, such as [If "supplement" is 1 then nothing, 2 then "external analepsis", and 3 then “external analepsis” & “external prolepsis”]. When a same kind of technique is selected by more than one rule, the narrator takes the number of times of this technique to be used, from one rule which has the greatest number of the technique.

Table 1: 13 kinds of discourse techniques

External analepsis: Narrating past events which are positioned outside of story’s time range (i.e., not contained in the story).
Complementary analepsis_ellipsis: Narrating past events which are lacked of the original position.
Complementary analepsis_paralipsis: Narrating past events which are partially lacked of the original position.
Repetitive analepsis: Narrating past events once more.
External prolepsis: Narrating prospective events which are positioned outside of story’s time range (i.e., not contained in the story).
Complementary prolepsis_ellipsis: Narrating prospective events and these events are lacked of the original position.
Complementary prolepsis_paralipsis: Narrating prospective events and these events are partially lacked of the original position.
Repetitive prolepsis: Narrating prospective events and these events are narrated at the original position once more.
Achronie: Narrating events which have unidentified temporal relation with time of story.
Pause: Pausing temporal progress of the story by inserting descriptions.
Implicit ellipsis: Skipping one part of story.
Repeating: Narrating same events twice.
Paralipsis: Narrating less information than original sequence of the events.

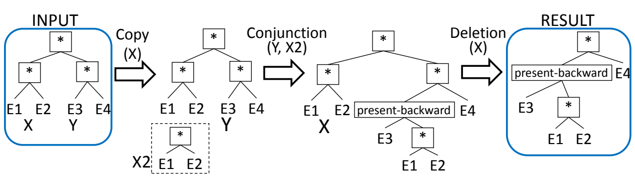

Figure 1: The transformation process of “complementary analepsis_ellipsis”

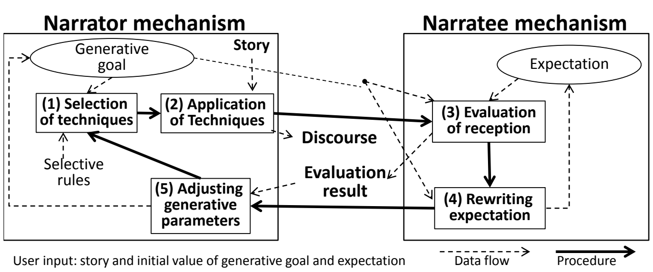

Figure 2: The overview of control mechanism

Table 2: Important terms in the control mechanism

Generative goal	Discourse parameters which represent the narrator’s direction of discourse generation.
Expectation	Discourse parameters which represent the expected discourse features by the narratee. Each parameter has two kinds of attribu-tions which are “degree of desire” and “number of sufficiency”.
Degree of desire	This is numerical value and it represents the strength of expectation which is represented by the value of the parameter.
Number of sufficiency	This is number of time the parameter was sufficed. Suffice means the accordance of a value of generative parameter and a value of expectation parameter.
Degree of satisfaction	Degree of satisfaction in narratee’s each expectation parameter to narrator’s generative goal.
Indication	An annunciation to the narrator about the parameter which was the least “degree of satisfaction”.
Getting tired	The narratee is boring with the expected discourse, namely “degree of satisfaction” is decreased.
Deviation	The narrator intentionally sets a generative goal which counters the expectation of the narratee.

(2) Application of Techniques Narrator mechanism applies all selected techniques to the structure. The interference among techniques sometimes arises. For example, an inserted node by “repeating” is removed by “implicit ellipsis”. For avoiding such phenomena, we determined the order of priority that techniques are applied. Removal techniques like “implicit ellipsis” have higher priority than additional techniques like “pause”. The position for a technique to be applied is decided using some heuristic constraint rules relevant to the node’s size mainly. For instance, the large internal nodes containing more than 7 leafs can not be the position “implicit ellipsis” is applied.

(3) Evaluation of Reception First, the narratee calculates the degree of satisfaction in every expectation’s parameter. Here, higher satisfaction can be obtained when a more strongly desired parameter is satisfied. Next, narratee calculates and indicates one parameter with the lowest satisfaction. If two or more parameters have the lowest satisfaction, the parameter which has smaller subscript number will be selected. For example, when length (p_4) and hiding (p_5) were the lowest, the former is selected. The result is described as a pair of the name of parameter and the evaluation value.

(4) Rewriting Expectation The narratee rewrites the expectation parameters through following two processes. First process rewrites the number of sufficiency and the degree of desire. The former is increased when the narratee received the sufficed discourse in each time. And this change causes the rise and fall in the degree of satisfaction as shown in Figure 3. And, n_p in the figure sets a turning point of the degree of satisfaction. Smaller n_p means the narratee is get tired easily. Through the generation cycle, such change occurs in each of ten parameters independently and repeatedly. In another process, a parameter’s value caused by the reception of a deviated discourse is renewed.

(5) Adjusting Generative Parameters The narrator rewrites one of generative parameter’s values according to the indication from the narratee. If there are no parameters to be changed, this process is skipped. “Deviation” is done in this step when narratee got tired in the expectation parameter. It randomly alters the value of parameter got tired with a value from 1 to 3 except for the current value. In the next cycle (step 4), narratee will rewrite the deviated parameter’s value.

Implementation and Execution Example

We implemented the system with Common Lisp. It mainly consists of three main elements: discourse techniques, narrator mechanism, and narrate mechanism. The program contains about 60 kinds of defined functions. Story and discourse are described with the same form of list. Moreover, we preliminarily provide supplemental data for events and descriptive information to use in “external analepsis”, “external prolepsis”, “achronie”, and “pause”. The system finally outputs a list of generated discourse and a Japanese natural language text. The latter is generated by a simple natural language sentences generation program we have originally developed. Table 3 shows an execution example which contains an input story, generative parameters, and a generated discourse. Both input/output are also described in natural language. In the generated discourse, 13 kinds of discourse techniques are applying. In addition, the input story directly uses a generated result of a story generation system by (Ogata & Terano, 1991) which uses a story grammar based on Propp theory (Propp, 1969). This shows an actual case this proposed system can be combined with other components in the narrative generation system architecture.

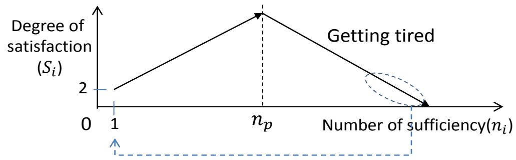

Figure 3: Changing pattern of the degree of satisfaction

Table 3: An execution example

Input story
A snake abducted a princess. An older woman sang a grief-stricken song. Ivan resolved at searching the princess. Ivan departed from the town. Ivan battled with the snake. Ivan got arm wounded by the snake. Ivan won against the snake. Ivan abducted the princess. Ivan departed from the snake's country. The snake flew in the air to the snake's country. The snake followed Ivan. Ivan hid himself to a rock. The princess found Ivan's wound. Dwarfs built a palace. Ivan lived in the palace. Ivan married with the princess.
Generative goal
supplement:3, complexity:2, suspense:3, length:1, hiding:1, descriptive-ness:2, repetition:2, diffuseness:2, implication:3, temporal-independency:2
Generated discourse
An older woman sang a grief-stricken song. The woman was born. (And) the woman grew in a town. (Now,) Ivan battled with a snake in the snake's country. Ivan got arm wounded by the snake. (But) Ivan won against the snake. (And) Ivan departed from the snake's country. The snake followed Ivan. (A few years later,) the older woman will get weak and die. (By the way,) the snake prophesied that dwarfs will build a palace. Ivan hid himself to a rock. A princess found Ivan's wound. The snake's country is slightly dark. Ivan's wound is bleeding. The princess is beautiful. (Soon after,) Ivan lived in a palace. (A short time ago,) dwarfs built this palace. Dwarfs built this palace. Ivan married with the princess. (Go back to the time of beginning,) the snake abducted the princess. The older woman sang a grief-stricken song. Ivan abducted the princess. Ivan departed the snake's country. (At that time,) Ivan prophesied that dwarfs will build a palace, (and) dwarfs will build a palace. (By the way,) somewhere a bear went to farming village .The bear attacked a farmer.

Operation Checks and Evaluations

We think that the evaluation of narrative generation system should be extremely done with a goal of narrative qualitative progress such as the improvement of creativity and interestingness. For example, Callaway and Lester (2002) proposed some evaluation items although the aspect of narrative comparatively surface language generation and Akimoto and Ogata (2009) organized evaluation criteria comprehensively. However, as the previous step, we attempt fundamental checks of the performance and simple evaluations. First two attempts are for the performance confirmation. In the first check, we analyze the aspect of logical structure in generated discourse representations. Next, an important purpose of the current system is the realization of no arbitrary diversity in the generation. First is a simple attempt for confirming whether changing generative goals results in the diversity of generated texts. And, second is an experiment for investigating narrative diversity through a generation cycle based on the interaction between narrator and narratee. In the last experiment, we quantitatively verify the correspondence relationship between used parameters and generated discourses. All experiments use the input story in preceding section.

A Structural Analysis of Generated Discourse

First, as a confirmation of the system's performance, we explain the overall structure of the result shown in Table 3. The outline of input story is that "A snake abducts a princess, and then Ivan rescues the princess from the snake, and then Ivan married the princess". Whereas, the output discourse has some features: (a) some events relating to the princess are hidden at the early part of the discourse, and are revealed after the marriage, and, (b) the discourse is longer than the input obviously. Moreover, we confirmed although generated discourse is structurally different from the story, both have a same semantic content. This coincides with the definition of the relationship between story and discourse. Next, we analyzed the transformation process of above result to check the logical correctness in the processing of used techniques and confirmed that each technique was correctly functioning as the individual level. However, we found out some matters at the level of combinatorial application of techniques. For example, a node inserted by "complementary analepsis_paralipse" was additionally moved by "complementary analepsis_ellipsis", that is, the result of the former was negated by the latter. This topic is generalized that a part of tree constructed by previously applied discourse techniques is additionally transformed by the later techniques. Such phenomenon, i.e., the interference among techniques may bring logical errors in a discourse structure. For instance, under the "present-backward" relation, right side's child nodes may contain posterior events to left side's child nodes. To solve such problem, we prepared some heuristic constraints and priority order rules to apply techniques in step 2 in the control mechanism.

Diverse Generation by Changing Parameters

Although it is no wonder in a sense, one of the merits in the proposed mechanism is that the diversity of generation brought by changing generative parameters. This characteristic is relating to a basic concept in the narrative generation system project of the flexible generation from fragmentary narrative elements and techniques. We confirmed generation diversity using "measured values" which means numerical numbers calculated based on the measurement criteria for each parameter. These values are automatically calculated from generated discourse using an embedded program routine. The various kinds of discourses are generated by different generative parameters such as very short one, longer and relatively complex ordered one, and so on. The obvious changes of measured values were caused by the change of values of the parameters. On the other hand, we confirmed that the system generates discourse structures in a certain range from same generative parameters. For example, 100 results generated from a same story (Table 3) and a set of generative parameters which generates very short discourse, the range of measured value "length" was 6 to 11. In summary, we could confirm that a certain degree of generative diversity is actualized from a generative goal and the change of parameters causes the change of the range of generation.

Diverse Generation through Continuous Cycle

The objective of this experiment is to investigate the different changing patterns of a circulative discourse generation process based on the different values of n_p. We executed the program respectively 10000 cycles for two kinds of n_p, 20 and 200. Figure 4 shows the change of four measured values in generated discourses. However, although the only first 500 cycles are shown, a similar pattern of change was continued after that. Two types of changing patterns exist. First is a micro level changing pattern based on same generative parameters occurring in each cycle. However, in this figure, "supplement" has not such kind of change. Another type is a macro level changing pattern caused by different generative parameters. The frequency in this kind of change is influenced by the value of n_p, and more frequent changes occur with smaller value of n_p. This fact indicates that intentional or strategic control of the system's behavior may become possible by adjusting the value of

n_p. For example, if we want to generate in a wide range of discourses, we can set smaller values of n_p. In contrast, if we want to generate in a narrow range of discourses, we can set larger values of n_p. Next, we focus on the range of generated discourses. In each measured value, there was a certain range as shown in Figure 4. On the other hand, as the combinations of measured values, 18765 patterns of discourse texts were generated from above 20000 discourses as the pattern which has completely similar measured values. In summary, the grasp of generative characteristics by parameters is connected to the development of a variety of control strategies. In addition, expansions of the existing control mechanism are also conceivable. The circulative generation process in the mechanism is thought of as a kind of closed-loop because same a changing pattern is repeating through a cycle. Regarding this, we programmed a simple mechanism which manipulates a specific parameter intentionally or randomly to create a part exceeding circulative loop. For example, by increasing a parameter's value incrementally, the corresponding aspect in discourse generation deviates from the closed-loop. Such a kind of breakdown or mutation may connect to narrative creativity or interestingness. These are implications for system implementation the experiments have. On the other hand, this kind of trial exploits a possibility of theoretical approach to creative genres like literature in terms of providing an experimental method to narratology, reception theory in this case.

Correspondence between Generative Parameters and Generated Discourse

We programmed a function which generates discourse texts by all (59049) combinations of generative parameters to quantitatively confirm the correspondence between used parameters and generated texts. Table 4 shows all of the correlation coefficient between each generative parameter and each measured value. In this table, vertical line and horizontal line respectively shows generative parameters and measured values. Each intersection means their correlation coefficient. In each parameter,

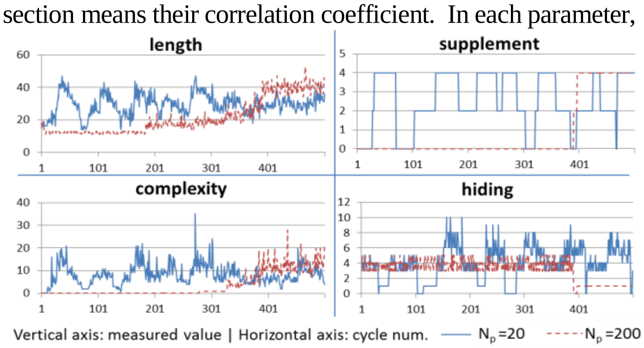

Figure 4: Changing parameters through a generation cycle

Table 4: Correlation coefficients between generative parameters and measured values

Generative goal	Measured value: Supplement	Complexity	Suspense	Length	Hiding	Descriptiveness	Repetition	Diffuseness	Implication	Temporal-independency
Supplement	0.76	0.19	−0.01	0.22	−0.00	−0.01	0.00	0.00	0.22	0.00
Complexity	−0.00	0.41	0.26	0.22	−0.00	0.00	0.21	0.17	0.11	0.14
Suspense	−0.00	0.29	0.35	0.14	0.00	−0.00	0.16	0.13	0.01	0.00
Length	0.19	0.05	0.01	0.39	−0.28	0.45	0.04	0.19	0.00	0.14
Hiding	0.00	0.06	−0.07	−0.26	0.69	0.01	0.02	−0.37	−0.01	0.00
Descriptiveness	−0.00	−0.00	−0.00	0.23	−0.00	0.61	−0.00	−0.00	0.00	0.00
Repetition	−0.00	−0.06	−0.09	0.23	−0.00	0.00	0.40	0.33	0.00	0.00
Diffuseness	0.00	0.00	−0.02	0.25	−0.28	−0.00	0.22	0.34	0.00	0.00
Implication	0.38	0.40	−0.04	0.28	−0.00	−0.01	0.19	0.16	0.81	0.00
Temporal-independency	0.00	0.21	−0.02	0.19	0.00	0.00	0.23	0.19	−0.00	0.88

higher value in the corresponding measured value's column (shaded one) and smaller values in other columns mean that the parameter is clearly reflected into the generated text. As a result, these are not complete correlations because the measured value by a parameter is sometimes influenced by the effect of other parameters. For example, the measured value by "length" is influenced by "descriptiveness" parameter. And, as correlations in "complexity", "suspense", "length", "repetition", and "diffuseness" were relatively weak, a reorganization of the correspondences between parameters and discourse techniques is required. As an idea, we are considering a method for hierarchically organizing parameters according to the abstraction level. For instance, parameters like "length" influenced by parameters such as "supplement" and "descriptiveness" may be positioned at the lower or more concrete layer in the hierarchy. In this hierarchical model, each technique is linked to one or more lower parameters which are influenced by the technique.

Overall Discussion and Future Issues

This section shows more general discussions and future directions from several standpoints.

Toward the Expansion of Control Mechanism

Proposed system has the capacity to generate diverse discourses within a certain definite range based on the automatic change of both sets of parameters for generation (narrator) and evaluation (narrate). The changing pattern in discourse structures in a circulative process is based on variable n_p. In this mechanism, discourse generation is principally executed automatically. In contrast, as stated in previous section, we are considering a method with more intentional and conscious mechanism to control generation. We prepared an experimental program repeating discourse generation based on a direction which a real user directly gave. By increasing or decreasing the values of "length" and "complexity" intentionally, this program repeats the rises & falls or continues to extend the length. For instance, we confirmed that the program performed just as a given direction and very long outputs were generated. The measured value of "length" was 149 as maximum. Another idea is about "deviation" process in the narrator (Table 2). Although current system changes only one parameter's value randomly in deviation process, we experimentally modified the system to be able to adjust the number of changing parameters in deviation process. As a result, we confirmed more number of changing parameters causes more rapid change of outputs. These experiments show that proposed control mechanism is an expandable framework based on the strategic and flexible adjustment of parameters.

An Application for Narrative Creation Support

Although this research is directly aiming at automatic narrative generation, at the same time, we are involved in the planning of system for supporting user's narrative creation with the automatic generation function. For example, the system automatically generates diverse narrative texts and then the user selects one or more outputs to complete or expand by processing them as a kind of narrative material. In the case, narrative generation mechanism is corresponding to a function for stimulating user's thought and inspiration. To investigate the idea, next simple experiments is attempted. First, we selected two preferred texts from many outputs by the system (by the input information in Table 3). At this time, we can see graphs of measured values as shown in Figure 4 to grasp parameters' characteristics in generated discourses. And then, we created a new story by the processing, expansion, and elaboration, moreover by combining two materials into one story. Human strong point is the creating of complex or complicated psychological narrative simulations and the processing of rhetorical techniques on surface text representation. On the other hand, machine's special skill is the generation of complex or complicated sequences in temporal progression and the logical processing of other discourse elements, and machine has the capacity to be able to generate superhuman texts, though, they may sometimes unnatural. Collaborative narrative creation or creation support by computer is one of the future directions in this research.

Issues for Introducing Narratology

In this proposal of the application of Genette theory, we do not reach the comprehensive introduction. However, as we provided a common method for implementing discourse techniques, we can directly use it to extend the range of covering Genette based techniques and other categories. Previously, we have been developing several elemental systems for discourse techniques including order, distance, focalization, and other categories (Ogata et al. (2004) shows their overviews). However, these programs were not integrated as a whole system because of different data forms and processing methods. The first step for the integration at the level of discourse becomes the integration of existing functions into the proposed framework. On the other hand, the proposition of computational formation and implementation inspired by Jauss reception theory is also an original result in this paper. Although we stated the topic of individual narrator/narratee and collective ones, other various issues. For example, the narratee mechanism does not refer to generated discourse itself, and the narratee's reception pattern, which is the process of rise and fall in the degree of satisfaction, is preliminarily fixed. These issues will be solved through an exploratory approach in the future.

The Integration with Narrative Generation System

Proposed system is positioned as a module of the narrative generation system. To integrate it into the system, first, it is necessary that the output data by the story generation phase becomes the input data of the discourse phase by unifying the form of knowledge representations. Regarding this, a tentative experimental version of integrated narrative generation system is already implemented by Akimoto and Ogata (2011). Next issue is the revision and expansion of discourse mechanism itself. Our immediate goal is to develop a systematic set of discourse techniques including all categories of Genette theory. At the same time, other types of techniques the theory does not describe are also required to be added into the comprehensive discourse mechanism. For example, Genette did not refer to the concrete way of "description" and "explanation" for character, object, and so on, at least systematically or formally. This sort of micro discourse techniques is a topic that has been discussing in the field of AI and natural language processing, and by the medium of this part, literary or narratological knowledge and AI-based knowledge will be blended in a narrative generation system. Moreover, we plan to expand the proposed narrative control method based on the interaction between narrator and narratee inside the system to an entire system including story phase and surface representation phases.

Conclusions

This paper proposed a computational system of narrative discourse generation and its implementation. In the system, Genette's discourse theory is reconstructed as discourse techniques which transform the tree structure for a story into discourse structures. Also, we introduced Jauss's reception theory to construct the control mechanism, which continues discourse generation through generation cycles based on the interaction between both narrator and narratee mechanisms. Moreover, we did two kinds of performance checks and two types of evaluation experiments and confirmed that the system generates diverse discourse structures on the rough correspondence with generative parameters. And furthermore, this study showed that two different types of literary knowledge are organically integrated into a system's framework. At last, although this research does not directly treat the aspect of human cognition, as mentioned above, this indicates that advanced literary knowledge which is an important part at human cognition can be studied as a system, especially a computational system, more essentially beyond the traditional boundaries of fields of study. This is also a significance of cognitive science in a wide sense.

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