J Vis (2010) 13:355–363
DOI 10.1007/s12650-010-0050-1

REGULAR PAPER

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Stereoscopic story visualization in literary works demonstrated by Shakespeare's plays

Received: 7 January 2010 / Accepted: 5 July 2010 / Published online: 27 July 2010

Abstract A stereoscopic method of identifying story patterns in literary works is newly developed. The pattern is extracted from textual information by the detection of thematically assigned keywords, and depicted as visual imageries. The applicability of the method is demonstrated in several of Shakespeare's plays. The complex scenario patterns in Shakespeare's tragedies are successfully captured with applying the method for two different themes in each play. As the result, the organization of story accompanying multiple themes in a single play has been obtained as a pair of visual imageries, i.e. stereoscopic story visualization. This approach, in combination with a quadrant analysis of the plots, allows us in interpretation further complexity of human psychology in the characters and scene-by-scene transitions in each play.

Keywords Literary works · Story mining · Shakespeare · Visualization · Text analysis

1 Introduction

Computer-aided linguistics has achieved a variety of text information transfer via current electronic network, such as for language translation, topic mining, and corpus classification (Singh and Dey 2005; Lee et al. 2007). Some of them contribute to human–machine interface in the field of artificial intelligence. These advancements feed-backed to the literary research, and have created new styles of approach not only current democratic arts, but also classic literatures (Shillingsburg 2006). Computer's understanding of a meaning in complex natural sentences is ongoing research, and extracting of exact meaning of a single sentence among literary context requires a highly sophisticated procedure. On the other hand, grasping of global story structure is relatively easy with computing number density of a limited number of keywords relevant to the theme assigned. This is explained with the law of Pragnanz in text (Rockwell et al. 1999). The law tells us the importance of dual recognition between local plots and global trend to identify what the local plots mean. The same manner is applicable to story recognition in literary works.

In our previous paper (Yamada and Murai 2009), an original method for generating visual imagery that expresses the story pattern was proposed. The method was based on the interpolation of the scattered keyword distributions with a help of ellipsoidal differential equations (Ido et al. 2002; Ido and Murai 2006).

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The mathematical base was completely the same as the one for particle tracking velocimetry for fluid flow measurement (Murai et al. 2008). The target of interpolation changes from fluid velocity to scattered keyword distribution. Counting of designated keywords in literature is, in fact, a classic way in literary research as early employed by Spurgeon (1935). Wavelet analysis of the counts by Inami et al. (2007) succeeded in quantitative evaluation of a story flow. In our case, the use of Laplace equation realized to derive a mathematically unique solution that is a scalar harmonic function connecting local and global structure of a story. Another important issue in literary works is an overlap of multiple different stories in a single work. The overlap strengthens the interest of a story creates the complexity on characters and provides a deviation of interpretation in readers and such a story over the multiple themes must be considered when the story pattern is visualized. In this paper, stereoscopic story visualization is presented to propose a solution of this problem. The visualization performance is demonstrated by several of Shakespeare's plays. From the different views in computed visual imageries, the connection of two themes is also evaluated with quadrant analysis.

2 Method of visualization

Recent advances in text-computing technologies enable the assessment of document similarities and hierarchical structures; as reported by Andrews et al. (2002), Keim (2002) and Havre et al. (2002). These techniques extract the linguistic structure of documents in a logical way. Our study, however, aims at a visual understanding of a story pattern, not just by analyzing its linguistic structure. The present story visualization includes a method to represent the results of a text analysis; i.e. a pair of analytic and synthetic processes is applied to complete the story visualization. Furthermore, the visualization is implemented two-dimensionally so that observers can visually recognize the story pattern from the imageries, similarly to the visualization of natural phenomena. We believe that such a combination of text analysis and representation provides observers with the feeling that a story is actually visualized. However, a difference between story visualization and that from natural sciences is that the target of the visualization of the former involves multiple aspects that depend on the theme to be visualized since literary works are an art form, i.e. human intellectual products. In the field of arts, there can be no absolute way for interpretation. The results will be dependent on the personal backgrounds of writers and readers. Nevertheless, text analysis can extract an invariant and objective structure of a story because no artificial or subjective operation is introduced into the process of visualization. Our method for story visualization is constructed below.

2.1 Signification intensity distribution

We estimate the strength of meaning in a story by the numerical value computed from the number density of keywords. The definition and the mathematical characteristics were explained in our earlier paper (Yamada and Murai 2009). No name was given to this value in that earlier paper, here we call it the "signification intensity distribution" (SID). The naming is derived from the fact that the vale is not a simple count of keywords, but indicates the status between two contrastive conditions that form the kernel of the story. Furthermore, as the procedure for making a two-dimensional canvas for story visualization was not elaborated in our earlier paper, we detail this procedure below.

Figure 1 shows a sample of the process to compute the SID. The central picture indicates a distribution for all the words in the text, which are arranged inside a square domain. The order of the word allocation is defined as shown in the left figure. The lateral and the vertical coordinates of the square are the hour hand and the minute hands from the start of the story. In the case of Shakespeare's original text for *Othello,* which consists of 35,965 words in total, the two-dimensional mapping is performed on 190 by 190 pixels. The right picture is the SID. In the case of the sample, a contrast of happiness (light yellow) and sadness (dark green) is presented. These are extracted from two groups of words. The value of the SID in the keyword location is defined as $s = +1$ for one group, and $s = -1$ for the other. A value between these two is generated by adopting an interpolation algorithm for two-dimensional discrete data. This interpolation algorithm was originally developed by one of the authors as a post-processing technique for particle tracking velocimetry (Ido et al. 2002). The same algorithm is applicable to story visualization from scattered keywords. As a result of the interpolation, a two-dimensional continuous distribution is obtained; this is represented by a colorful pattern through utilization of arbitrary color coding as defined by the user.

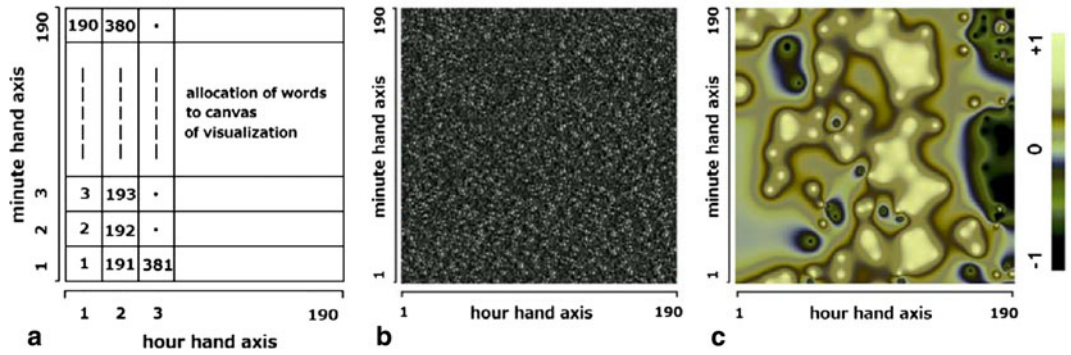


Fig. 1 Detection of keywords and its conversion to signification intensity distribution on the canvas of visualization. **a** The order of word allocation in square canvas. **b** The distribution of all the words in a single play work. **c** Signification intensity distribution of happiness and sadness in *Othello*

2.2 Selection of important keywords

To assess the functionality of story pattern recognition, any type of textual source can be targeted, such as in drama, novels, commentary, documentary, and newspaper articles. We chose plays by William Shakespeare (1564–1616) for our research for the following reasons. Shakespeare's works are well-known across many countries and over centuries because of superb expression of his poems, and extinguish creativity of story as well as unique characters in his play. Using his works, we believe that the performance evaluation of the present analysis goes to the heart of the issues involving computer literary interpretation. To compute the literature data, we used the electronic library of the complete works of Shakespeare: available on T-Time ver.5.5.7.6, Voyager Japan Inc. The source code of the electronic library is written in HTML, and we eliminated all the control codes to storage, all the individual words in a single-word strings-characters array. All the operations from text loading to graphical output were realized with a single program which is coded by the authors in Microsoft Visual Basic.

When suitable keywords are selected for story visualization, statistic understanding of important words appearing in a text is fundamental. This provides the objectiveness of the keyword selection and reinforces our knowledge on each play. Table 1 shows a list of the story components of all Shakespeare's plays. The table is sorted by publication date estimated. The column "Code" indicates the international abbreviations of the titles of Shakespeare's works. The column "Type" represents classification into *H*: history, *C*: comedy, *T*: tragedy, and *R*: romance. The next column "Word Count" indicates the total number of words in each play, as counted by our program software. The values in the next six columns show relative appearance ratios of word groups classified into six categories. The first word group "love" contains the words "love," and "affection" including their declensions. In the same manner, "happy," "live," "sad," "kill" and "death" are defined as other groups. The relative appearance ratio is defined by the frequency of keywords normalized by that of averaged value for all 37 plays. As the value becomes larger than unity, it objectively suggests that the topic of the group is set as the primary theme of the story. A comprehensive trend is visualized by the color bars attached on the right side of the table. For example, play no. 9, *Love's Labour's Lost* deals with the theme of "love." By sorting the values from highest, the top three plays of each theme are found automatically. Those of the theme "killing", for instance, are computed to be *Othello*, *King Richard the Third*, and *Hamlet*. The combination of two themes for stereoscopic visualization is selected based on these statistic results.

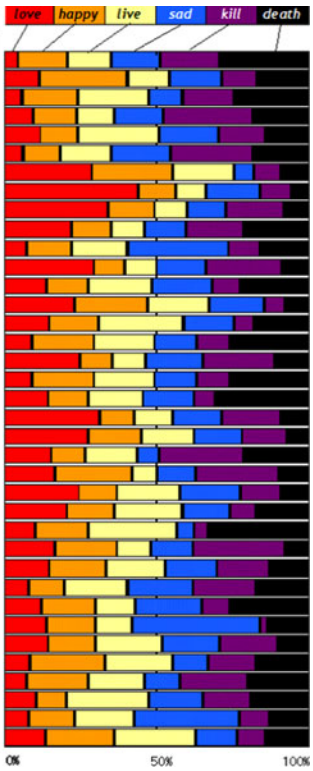
3 Stereoscopic visualization of a story

We know that the precise trend a story takes cannot be represented by only the keywords. However, this is the simplest yet most important method in literature analysis. For Shakespeare's plays, keyword counting has been adopted to reveal literary essences; see Spurgeon (1935), Foster (1997), Kolata (1986), and Driver (1986). When the keywords focused on are changed, a different feature of the story would naturally be extracted. In the same manner, when the two contrastive keywords are changed, a different pattern is derived

Table 1 Story components of Shakespeare's plays classified into six categories

No	Year	Code*	Title of Play	Type*	Words Count	Relative Appearance Ratio of Word Group					
						love	happy	live	sad	kill	death
1	1591	2H6	The Second Part of King Henry the Sixth	H	33620	0.27	0.96	0.87	0.98	1.15	1.76
2	1591	3H6	The Third Part of King Henry the Sixth	H	33186	0.67	1.76	0.84	0.99	0.71	1.03
3	1592	1H6	The First Part of King Henry the Sixth	H	28856	0.35	1.11	1.39	0.65	1.02	1.48
4	1593	R3	King Richard the Third	H	40389	0.55	0.85	0.76	0.98	1.72	1.13
5	1593	Err.	The Comedy of Errors	C	21020	0.69	0.76	1.61	1.13	0.95	0.86
6	1594	Tit.	Titus Andronicus	T	26428	0.38	0.71	1.00	1.19	1.59	1.12
7	1594	Shr.	The Taming of the Shrew	C	29116	1.73	1.59	1.21	0.38	0.53	0.57
8	1595	TGV	Two Gentlemen of Verona	C	24913	2.63	0.75	0.59	1.06	0.59	0.37
9	1595	LLL	Love's Labour's Lost	C	30907	2.04	0.92	0.63	0.76	1.16	0.49
10	1595	Rom.	Romeo and Juliet	T	33165	1.32	0.77	0.67	0.78	1.15	1.31
11	1596	R2	King Richard the Second	H	28409	0.43	0.88	1.10	2.00	0.62	0.96
12	1596	MND	A Midsummer Night's Dream	C	21854	1.76	0.65	0.58	0.97	1.52	0.53
13	1597	John	King John	H	26872	0.81	0.85	1.24	1.18	0.56	1.36
14	1597	MV	The Merchant of Venice	C	27530	1.39	1.41	1.21	1.10	0.42	0.47
15	1598	1H4	The First Part of King Henry the Fourth	H	32589	0.88	0.97	1.68	1.01	0.38	1.08
16	1598	2H4	The Second Part of King Henry the Fourth	H	35337	0.53	1.25	1.17	0.83	0.65	1.57
17	1599	Ado	Much Ado about Nothing	C	29874	1.48	0.66	0.64	1.14	1.41	0.68
18	1599	H5	King Henry the Fifth	H	35337	0.53	1.25	1.17	0.83	0.65	1.57
19	1600	JC	Julius Caesar	T	27255	0.85	0.79	1.06	1.03	0.42	1.85
20	1600	AYLI	As You Like It	C	29462	1.88	0.65	0.79	0.93	1.21	0.55
21	1600	TN	Twelfth Night	C	28511	1.65	1.05	1.03	0.94	0.89	0.43
22	1601	Ham.	Hamlet	T	41490	0.93	0.65	1.02	0.46	1.66	1.29
23	1601	Wiv.	The Merry Wives of Windsor	C	31504	1.01	1.49	0.51	0.73	1.66	0.59
24	1602	Tro.	Troilus and Cressida	T	36622	1.45	0.77	1.23	1.20	0.80	0.55
25	1603	AWW	All's Well That Ends Well	C	31802	1.22	0.93	1.33	0.96	0.49	1.07
26	1605	MM	Measure for Measure	C	29920	0.59	1.06	1.74	0.34	0.26	2.01
27	1605	Oth.	Othello	T	36986	1.00	1.22	0.65	0.82	1.84	0.47
28	1606	Lear	King Lear	T	37097	0.88	1.12	1.16	1.00	1.06	0.77
29	1606	Mac.	Macbeth	T	24218	0.45	0.71	1.26	1.26	1.26	1.05
30	1607	Ant.	Antony and Cleopatra	T	36047	0.69	1.11	0.79	1.29	0.58	1.55
31	1608	Cor.	Coriolanus	T	38240	0.81	0.98	0.74	2.51	0.14	0.82
32	1608	Tim.	Timon of Athens	T	26151	0.84	0.95	1.31	1.14	1.16	0.60
33	1609	Per.	Pericles	R	25121	0.49	1.48	1.35	0.67	0.95	1.06
34	1610	Cym.	Cymbeline	R	36370	0.43	1.22	1.09	0.74	1.31	1.22
35	1611	WT	The Winter's Tale	R	32332	0.62	0.60	1.62	1.07	0.94	1.16
36	1612	Temp.	The Tempest	R	22896	0.46	0.93	1.14	2.09	0.63	0.75
37	1613	H8	King Henry the Eighth	H	31977	0.80	1.37	1.58	0.83	0.59	0.84

*Play) International abbreviation code of Shakespeare's Play Title, *Type) Type of Play. H: History, C: Comedy, T: Tragedy, R: Romance



for the SID. This concept leads to stereoscopic visualization of the story, and helps in enabling multiple inspections of literary works.

For stereoscopic visualization, we employ a spherical expression of the SID so that the beginning and the ending of a story are metaphors for the north and south poles, while the middle of a story corresponds to the equator (Murai and Yamada 2009). Word allocation order for this spherical expression is defined by converting the lateral and vertical coordinates in Fig. 1c to axial and longitudinal coordinates, respectively, of the planet. The visualized results are shown in Figs. 2, 3, 4, 5, 6 for five Shakespeare's tragedies. An original color pallet is used for chromatic visualization in each case. The color pallets are sampled from famous historical paintings relevant to individual plays, as in our earlier paper (Yamada and Murai 2009). A reason for employing these paintings is that the color in the paintings harmonizes with the mood within the play and so represents the story in color. We think that such artistic representation should be able to express visualized results of literary arts, i.e. art-to-art revisualization.

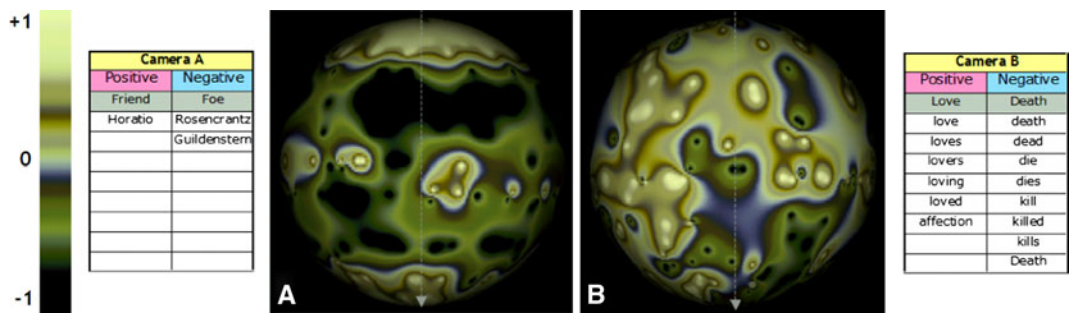


Fig. 2 Stereoscopic story visualization of *Hamlet*

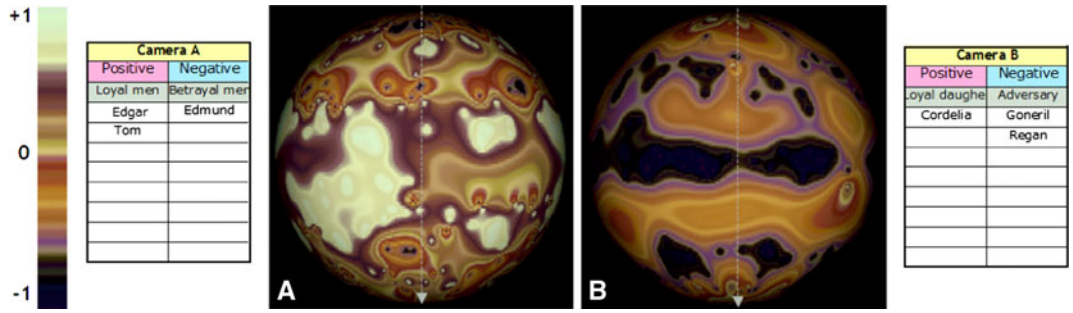


Fig. 3 Stereoscopic story visualization of *King Lear*

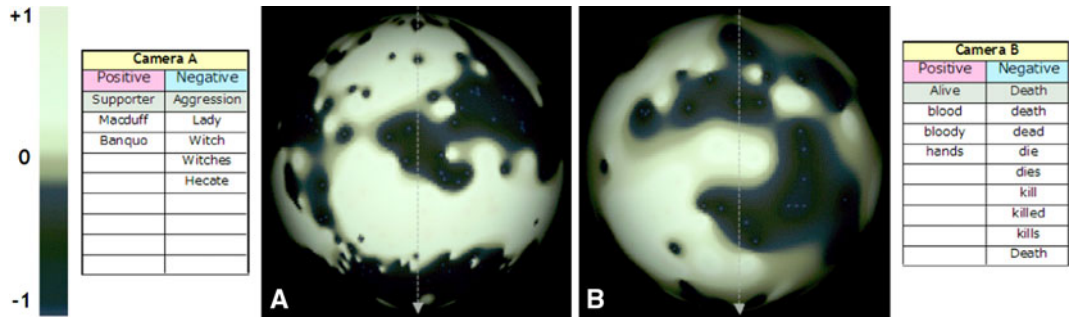


Fig. 4 Stereoscopic story visualization of *Macbeth*

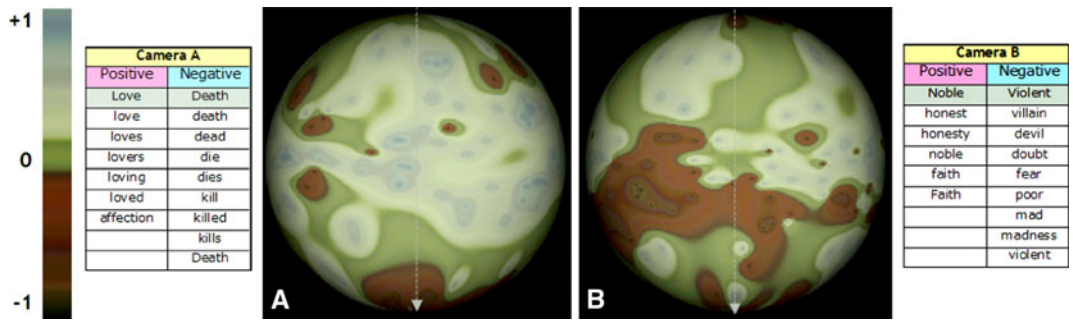


Fig. 5 Stereoscopic story visualization of *Othello*

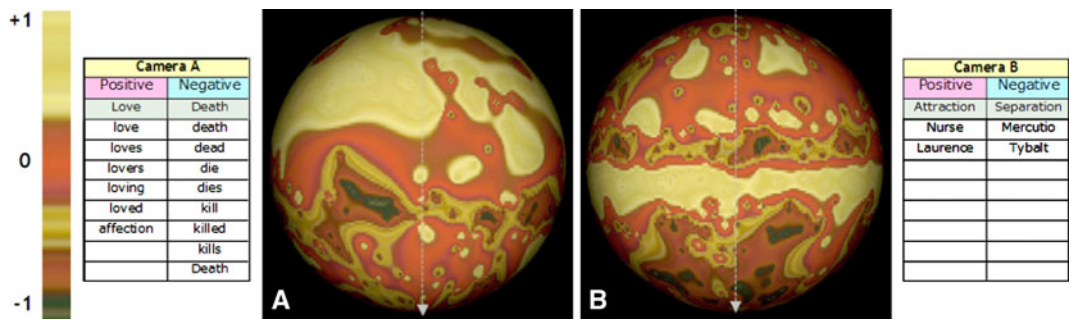


Fig. 6 Stereoscopic story visualization of *Romeo and Juliet*

3.1 Hamlet

Figure 2 shows the visualized story pattern of *Hamlet*, one of the best-known tragedies in the world. The plot centers on Hamlet's hatred for his uncle the king who killed his father and married his mother. Camera A visualizes the story by contrasting friend and foe while Camera B visualizes love and death. These two show different story pattern from each other. The visualization by Camera A depicts the story beginning with the trusting friend Horatio, who always helps Hamlet. It then progresses to describe his bad friends, Rosencrantz and Guildenstern, who appear as a dark region in the result. Since Horatio protects Hamlet's successor at the end, a positive region is depicted again near the south pole of the visualization. As shown here, the story is about friendship and betrayal as known in literary criticism. Although this primary scenario is structured thus, there is a secondary parallel story as visualized by Camera B. The first half of the play is about Hamlet's love for Ophelia as shown by light color. However, the story gradually turns to tragedy and eventually almost all the characters die as depicted by dark green areas in the southern hemisphere of the visualization. As these two pictures show the stereoscopic pattern recognition presents an easily understandable picture of a multi-story structure within a single play. The turmoil in Hamlet's heart owing to the interaction with surrounding characters, i.e. affecting the others and being affected by them are expressed by the resultant visualization.

3.2 King Lear

King Lear is a story of filial love and duty played out by Lear's three daughters and Gloucester's two sons. Figure 3 shows the pair of visualized stories of *King Lear*. Camera A focuses on the contrast of loyal and treacherous men towards Lear. Edgar is the loyal son of Gloucester, who plays major roles in the middle of the play as presented in white regions in the center. His half brother, Edmund deceives Edgar in the beginning and also hurts his own father who eventually dies. In anger about this, Edgar disguises himself as Tom and duels with Edmund to seek revenge. These parts of the play are described in the result as orange-colored interlaced layers between white and dark regions. Since contrastive roles of male and female characters appear in an interesting doubled structure of the story in this play, the secondary theme is defined by opposite attitudes of loyal and disloyal daughters of the king. The sharp change of color in Camera B matches the dramatic change in Lear's destiny, being swayed by the three female characters, his daughters Goneril, Regan and Cordelia. The story ends with the loyal daughter Cordelia's death while she is attempting to help her father. The results of stereoscopic visualization accurately portray the two concepts which change again and again throughout the play, as indicated by stripe patterns in the results.

3.3 Macbeth

Macbeth is the story of a Scottish king and his lady set in the eleventh century. The narrative begins with the prophecy of three witches that Macbeth will become king. Although Macbeth captures the throne after a brutal battle with the support of his wife, Lady Macbeth, he soon loses everything. The tragedy is of Macbeth's glory and ruin as well as virtue and evil. Figure 4 represents the visualized result of Camera A's contrast of Macbeth's male friendships and the negative influences from female characters. Camera B captures the binary scenes of life and death. The result shows that the story is made of a tightly entwined background of these issues, and it is consistent with the ominous mood of the play and the dramatic destiny of Macbeth. The two pictures generally correlate, but there are localized opposing points of reference. This is because the male characters act as Macbeth's competitors and the female characters influence and affect him as his supporters. Hence, both positive and negative factors coexist within individual characters. For this reason, the color pallet is chosen so that the story can be recognized as a binary structure where virtue and evil coexist with Macbeth's catastrophic destiny.

3.4 Othello

Figure 5 shows the visualized pattern of *Othello*. This play is known as a story of conflict within the heart of Othello. Camera A visualizes love and death. Othello's love for his young wife, Desdemona is shown in a bright color. However, she dies at the end: represented by a dark brown color. This progress of the scenario can be well explained by the result of Camera B which looks at two elements, nobility and violence with madness in the heart of Othello. His pure love for Desdemona changes to strong jealousy in the middle of

the play, a change which is contrived by his subordinate, Iago. This change of feeling is depicted with the brown belt on the sphere. It is at this point that the story turns towards the tragic ending of Othello killing his wife in a fit of jealousy. The resultant visualization shows the relationship of two contrasting states: First, Othello's nobility and his love for his wife; second, his jealous rage and suspicion tragedy. As demonstrated with this play, the stereoscopic visualization can help us in understanding how two separate scenarios are linked. In *Othello*, despite complex racial themes, the coupled story structure is clearly visualized due to the simplicity of the story.

3.5 Romeo and Juliet

Shakespeare's *Romeo and Juliet* tells of the love between a girl and a boy from opposing households. Figure 6 depicts the stereoscopic pattern. Camera A views the primary scenario by love as positive and death as negative. The first half of the play deals with their growing love, expressed with a golden yellow color. The story suddenly changes below the equator with the death of Juliet's cousin, Tybalt, who was killed by Romeo because Tybalt had stabbed Romeo's friend, Mercutio. Romeo and Juliet die in the final scene because they love each other. Hence, love and death are mixed as expressed by a number of spots in the southern hemisphere of the result. This primary structure of the story is made more interesting by four characters: the Nurse and Laurence try to support Romeo and Juliet in marriage, while Mercutio and Tybalt, however, consequently separate them. Camera B visualizes these factors so that the correlation between them is investigated. The dark layer just above the equator indicates the fighting between the two households, which correlates with the layer where the golden color fades in Camera A. The bright belt on the equator in Camera B corresponds to the scene in which the Nurse and Laurence cooperate for the marriage of Romeo and Juliet despite surrounding objection. As expressed by these two results, the beginning of this story is dominated by happiness and love; this love gradually turns to tragedy below the equator, despite the support of Laurence and the Nurse; finally, the dramatic and tragic ending is expressed by the combination of death and love.

4 Quadrant analysis of a story pattern

From the stereoscopic visualization data, a correlation pattern between two themes can be calculated. This correlation analysis contributes to the understanding of the dynamic structure from the beginning to the end of a story, to a quantitative evaluation of the relationship between the two themes, and to the validation of the combination of the two themes for stereoscopic visualization.

Figure 7a depicts how a correlation pattern is evaluated. The lateral axis is defined by theme A that corresponds to data from Camera A. The vertical axis is defined by theme B corresponding to data from Camera B. Both axes have a range from -1 to $+1$. Since the SID function becomes a vector distribution (u, v) when the stereoscopic story pattern is analyzed, the correlation is visualized by plotting the data (u, v) inside the square domain. By classifying all the plots into quadrant spaces: (1) $\{u > 0, v > 0\}$, (2) $\{u < 0, v > 0\}$, (3) $\{u < 0, v < 0\}$, and (4) $\{u > 0, v < 0\}$, how the two aspects relate to each other can be evaluated.

Figure 7b indicates the distribution of plots in the quadrant space for *Hamlet*. As the color bar represents, the story begins in red, and progresses to orange, yellow, green, sky blue, and ends in dark blue. In the case of *Hamlet*, the plot starts from the right, moves to the left, and comes back to the right again. The correlation between the two themes is weak because the plots within the narrative do not have any particular trend. This result expresses that the first theme (friend/foe) and the second theme (love/death) are nearly independent on each other. Namely, two different scenarios are present in the play. The trend is different for *King Lear* as shown in Fig. 7c. The story begins the first and the second quadrant spaces and then shifts to the fourth quadrant space before dispersing widely later. The plots in the fourth quadrant indicate that the two themes have a negative correlation, i.e. $uv < 0$. This region corresponds to the scene that Edgar supports to Lear while the two traitorous daughters, Goneril and Regan, resist against Lear. Interesting scenes for audience, such as this, often appear in the second and the fourth quadrant spaces which have negative correlations. The plots for *Macbeth* disperse widely from the center as shown in Fig. 7d. This matches the general interpretation that Shakespeare's *Macbeth* is dramatic due to the combined representation of glory and ruin as well as virtue and evil. On the other hand, the plots are distributed mainly in the quadrant spaces of positive correlation in the case of *Othello* as presented in Fig. 7e. This suggests that this type of narrative structure is

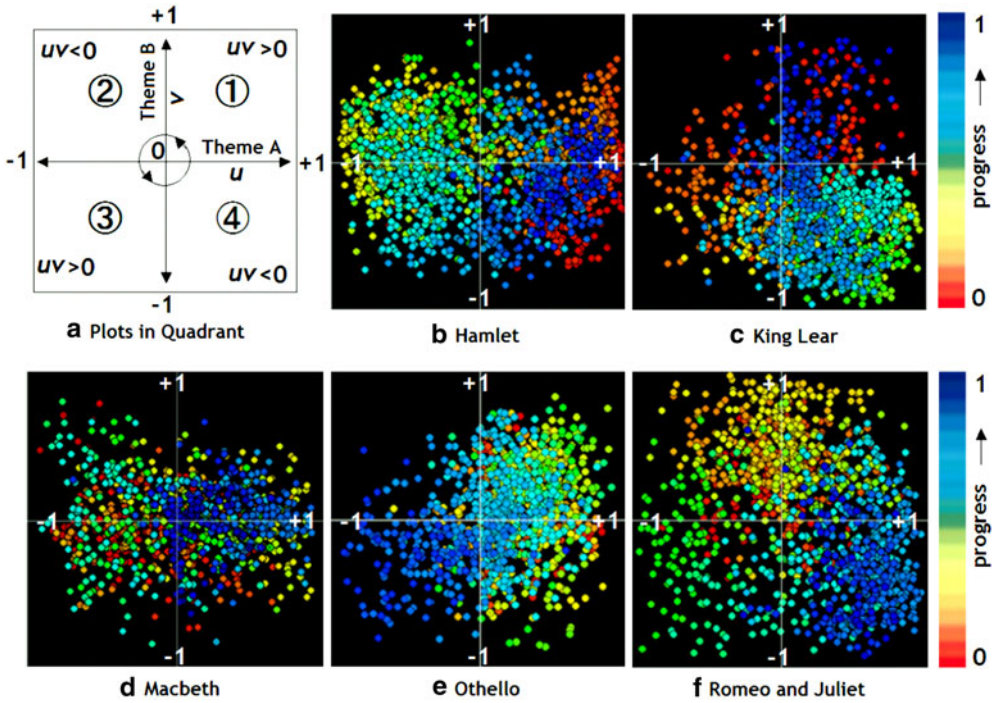


Fig. 7 Transition of quadrant plot distributions in story

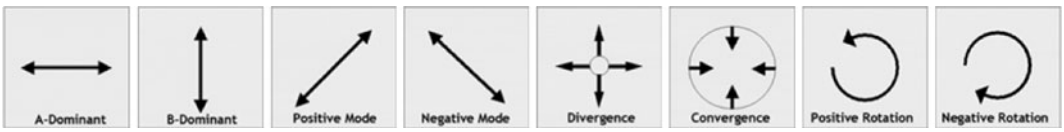


Fig. 8 Pattern classification of story transition

the most naturally occurring in literary works: no strong inconsistencies between two different views making it easy to be understood. In comparison, the plots in *Romeo and Juliet* are dynamically distributed with clear bias in the quadrant spaces as shown in Fig. 7f. The wide amplitudes in both directions display how its emotional intensity is strong and clear in each scene. The story begins from the center, shifts upward due to the maturation of their love, and then goes into the third quadrant space when conflict breaks out between the two households. The dramatic ending appears in the fourth quadrant space since Romeo and Juliet eventually die as a result of their love. The ending in the fourth quadrant space means that the primary and the secondary themes finish with the largest inconsistency, which is not seen in the other four plays dealt with in this paper.

Summarizing the function of the quadrant analysis presented here, it can extract two-dimensional story patterns as functions of time. When the plots take place in negative correlation spaces, it reveals fatal and tragic human psychologies, e.g. love and anguish become compatible. Figure 8 shows the classification of the two-dimensional story patterns into eight possible cases. The first two cases indicate the null correlation between the two themes as shown by the data of *Hamlet* in A-Dominant. The positive mode expresses an easy-to-understand story like *Othello*. Negative mode is seen in the first half of *King Lear* and the ending of *Romeo and Juliet*. The mode of divergence often emerges at the beginning of each story. The mode of convergence sometimes appears when the ending of a story is gently resolved after dramatic plots as in *King Lear*. The rotation of the plots in quadrant space means existence of a time lag between two themes. In the case of positive rotation, the primary scenario leads the secondary one. *Romeo and Juliet* involves this rotation in the latter half of the play. The negative rotation suggests that the secondary scenario actually drives the primary scenario. This case is rarely found, however, and such a case suggests that the primary and secondary themes should be exchanged.

5 Perspective on the basic concept

One of the problems that we need to address in this paper is how to define two themes for stereoscopic visualization. These need to be determined by the users of the visualization software, not automatically determined by the software. Hence, users need to understand certain background information about the literary work to be visualized. The stereoscopic visualization works best when the user can suitably define the two themes with relevant background knowledge. Nevertheless, the software still visualizes a somewhat significant story pattern even when the themes are selected without underlying rationale. If an irrelevant theme is adapted, no significant pattern will be visualized in the results. This also means that the present method is useful for judging if a story includes the assumed theme. With this function, the method can be applicable to count the number of themes underlying a story and such an application may lead to the automatic evaluation of the dimension of a story. For instance, the contrast between day and night is often highlighted in *Romeo and Juliet*, as analyzed in Spurgeon (1935). This suggests that the introduction of a third theme to the results in Sect. 3.5 makes sense. Thus, we never adhere to just a two-camera-based visualization to achieve stereoscopic story visualization.

6 Summary

A sequence to visualize a story and to detect patterns in the scenario structure was developed. For demonstration purposes, the five most dramatic tragedies by William Shakespeare were chosen. Our proposal for visualization of the story is to detect keywords in the text to derive the SID. The results of stereoscopic visualization implemented by a pair of different themes were seen to be generally consistent with our understanding of the actual narrative. The quadrant analysis applied to the result revealed the potential availability for mining the story structure in a multi-dimensional manner. We believe that this technique will be applicable to a variety of research fields not only for the traditional body of literature, but also for gauging fashions or trends involved in the latest literature.

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