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A Study - Design and Analysis of A Swing Bridge

Shreya Gupta
B.E. in civil Engineer
G.D. Rungta college of engg. And tech
Bhilai (C.G.), India

Anjali Thakur
B.E. in civil Engineer
G.D. Rungta college of engg. And tech
Bhilai (C.G.), India

Nirupama Sahu
B.E. in civil Engineer
G.D. Rungta college of engg. And tech
Bhilai (C.G.), India

Varsha Rani Painkra
B.E. in civil Engineer
G.D. Rungta college of engg. And tech
Bhilai (C.G.), India

Abstract: This study deals with the basic concepts and steps involved within the design and analysis of a swing bridge. There are different types of movable bridges used worldwide in field of bridge construction, while swing bridge can be a better alternative from the point of view of safety as well as economy. As we all know now days waterway transportation is quite famous and very useful to shorten the d

istances. Generally when we talk about water way transportation we assume about a ship crossing the river or a bridge over it for vehicular traffic, but assume if both can be achieve at a same time and same location. Main purpose of this study is to provide information about the swing bridge and promote its use in construction of bridges.

Keywords: swing bridge, type, centre bearing, rim bearing, design, calculation, load, rotation, construction.

1. INTRODUCTION

Swing span bridges are provided with a central pier and rotating machinery, the span of bridge rotates around the central pier. When normal road traffic has to cross the bridge, it is positioned on its close position and act like as a fixed bridge and allow them to pass over it and when a ship or any vessel has to pass the bridge is kept at 90 degree angle from its fixed position and hence allows the vessel to pass. Generally a clearance of 70m to 90m is required.

There can be two types of swing bridge on the basis of its working mechanism:

1. Centre bearing swing bridge
2. Rim bearing bridge

There is also a third type of swing bridge which is termed as bobtail swing bridge but that is not used for construction any more because it is not symmetric in structure and can be a cause of failure.

1.1 Centre bearing swing bridge

- In this type, span of the bridge is totally dependent on central pivoting pier.
- To prevent the bridge span from failure under unbalanced loads i.e. wind load, balance wheels are provided which rolls on a large-diameter circular track concentric with the pivot bearing.
- The design is based on the fact that the centre bearing supports all of the dead load when the span is in its open position. The live load is usually supported by centre and end lift devices which are
-
- actuated when the span is returned to the closed position.
- Rotation of the span is provided with the help of machines which are operated manually.

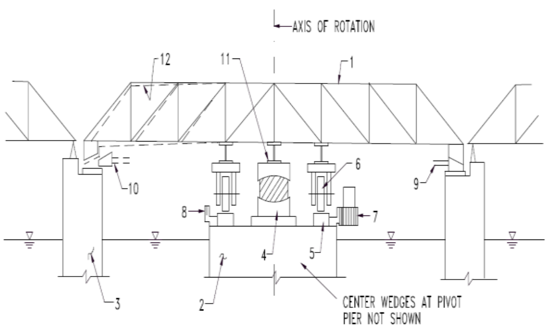


Figure. 1 Centre bearing swing bridge

1.2 Rim bearing swing bridge

- In rim bearing swing bridges, a minimum of two longitudinal spanning members are required to support the super structure.
- Tapered rollers are also provided because the distance travelled by the outer end is longer than that travelled by the inner end of the roller, for the provided angle of bridge rotation.
- In case of rim bearing mechanism when the bridge is fixed or in its closed position, it supports both dead load and live load. Rim bearings are quite handful for wide and heavily-loaded swing bridges.
- Load is transferred by the drum girder to a tapered tread plate which is supported by tapered rollers. Rotation of the span is achieved in the same manner as it was for the centre-bearing swing bridge.

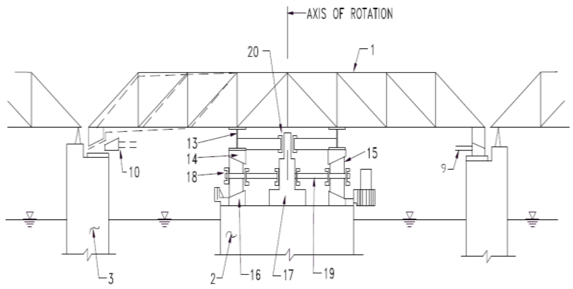


Figure. 2 Rim bearing swing bridge

2. LITERATURE SURVEY

I.Berger found that (march 2015) :

The history of swing bridges in New South Wales most likely commenced in Sydney, with it being noted that the earliest swing bridges in the colony were those erected at Wentworth Park, Pyrmont and Glebe Island in 1850, 1857 and 1862 respectively (Dare 1896, *Main Roads* 1973). The Pyrmont design consisted of a lattice deck which pivoted about a central pier and the Glebe Island design consisted of a single opening swing span mounted on the bridge abutment (Fig.4)

According to D. Healy (march 2015) :

The next development in swing bridge design was apparent on the Hay Bridge completed in 1873. The design consisted of lattice girder span supporting timber decking and the bridge was operated by hand. The drum was a composite of cast and wrought iron that was finally founded on a centre pier. It was noted by Mr G. S. Mullen, past Resident Engineer, that the Hay Bridge was operating satisfactorily with the frequency of openings being over times per annum in the 1880s (*Main Roads*, 1973). The swing span was locked shut in 1937 and the bridge was demolished in 1973 with the turntable relocated to Lions Park, Hay.

This type of bridge design was also adopted for the swing span on the Gladesville Bridge over Parramatta River completed in 1881, with reports that the operation was also satisfactory. Figure 8.8 is an elevation of this type of swing bridge design.

M. Tilley found that :

In 1885 a different type of swing bridge was constructed on the Fig Tree Bridge over the Lane Cove River (Fig.7) The swing span was a bob-tailed design which consisted of a shortened rear span. This type of bridge is usually adopted due to limited land availability. In order to balance the resultant differential in span masses a counterweight is mounted on the shorter span. There are some minor consequences for this type of design, namely the asymmetric wind loads that are experienced, however these can be catered for by strengthening the bridge where necessary (Waddell, 1916). Dual plate web girders are the main components of the bridge superstructure and they taper from 6 ft. at the abutment to 2 ft. at the pier. It is noteworthy that this design was also manually operated by a handle on deck level which passed through a number of gears before transferring rotation to the structure.

In 1892, John MacDonald prepared a design for a swing bridge to be built on the North Coast, over Cold stream River a tributary of the Clarence River near Maclean. The intention was that it would provide access for the tugs and barges associated with the sugar industry between the farms and the mill at Harwood (Fraser 1985).Only a small line drawing survives in MacDonald’s calculation books; the design is unusual in that it consists of a lattice trussed central pivoting span with what appear to be plate girder approaches. It would have been similar in some regards to the Sale Bridge in Victoria built in 1883.

Possibly as a result of the considerable expense involved, or potentially due to a lowering of demand from river traffic, this bridge was never built; a single lane timber beam bridge was erected at the crossing instead.

The completion of the Pyrmont Bridge in 1902 and the Glebe Island Bridge in 1903 represented a significant milestone in the Australian swing bridge design evolution. The designs are often cited in engineering literature as being at the forefront in the world for swing bridges at their time due to their electrical operation and large size (*Main Roads* 1953, Allan 1924, Fraser 1985)

Other Swing Bridges in Australia

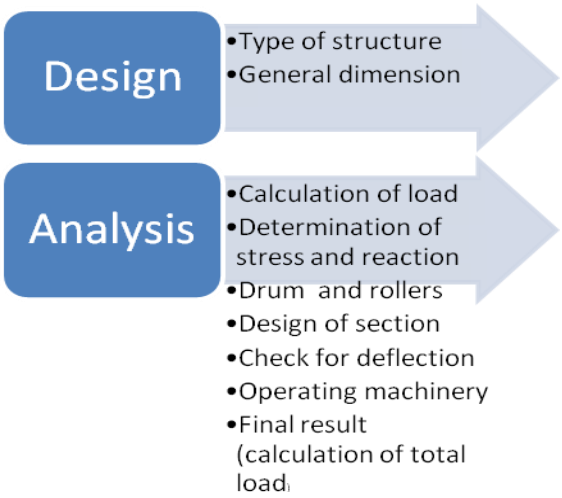
There have been at least ten sites in Australia where swing bridges have been erected. In Sydney Harbour there are two; Pyrmont and Glebe Island Bridges, four in Tasmania, two in Port Adelaide and one each in Queensland and Victoria. In several cases, when an early swing bridge reached the end of its service life, it was replaced by another.

The 1874 Bridgewater Bridge carried the Tasmanian Main Line Railway across the Derwent River. The swing span was supported off-centre to maximise the width of the navigation channel. A separate road bridge was opened in 1892 with a swing span designed for conversion to railway use. This was later converted to dual road and rail use in 1908 because the turntable of the road bridge was supported on timber piles and gave endless trouble. The existing bridge was opened in 1942 and carries both road and rail in separate corridors and has a lift span. The Institution of Engineers Australia placed a Historic Engineering marker on the remnants of the Jervois Swing Bridge which carried road vehicles, rail, trams and pedestrians across the Port River in Port Adelaide. It was built in 1878 and demolished in 1969.

Similarly to Pyrmont Bridge, several other swing bridges have been refurbished or restored and remain in existence. The 1883 road bridge at Sale, Victoria is restricted to foot traffic but is swung regularly at advertised times. The Victoria Bridge in Townsville built in 1889 was returned to use as a major community asset after restoration in 2001 by the Townsville City Council.

3. METHOD

Method is a way of providing solutions for the problems. While designing a swing bridge the method consists of the following steps as describe below in the flow chart:



3.1 Design

Whenever it comes to design any structure general dimension such as basic length and width are firstly calculated or assumed.

In case of swing bridge the dimension the bridge are calculated on the basis of existing bridge on the same river.

3.1.1 Type of structure

For the designing purpose the most common type of swing bridges may be divided into three classes :

a. Two span continuous
b. Three span continuous
c. Three span partially continuous

Chosen structure depends upon the length of the track to be designed.

3.1.2 General dimension:

The width of the bridge is fixed by the width of the track and side clearance is also considered in addition in width. It usually varies from seven to eight feet from the centre of track to the nearest inner part of the truss.

The depth of the floor system is taken between twenty-eight to swing bridges. The height of the bridge is calculated with the help of required clearance.

3.2 Analysis

3.2.1 Load calculation

Load (self weight) can be calculated using the following formula :

w = 6 L + 350

where L = length of span in feet,

w = weight of bridge per linear foot of span in pounds. (1 pounds = 4.448 Newton).

3.2.2 Determination of reaction:

Reactions formulas are given by professor:
P.E. Turnesure (3dec.1896) at **“ROSE POLYTECHNIC INSTITUTION”**

$$R_1 = P(1-K) - \frac{P}{4+6n}(K-K^3)$$

$$R_2 = PK + \frac{P}{4+6n}(K-K^3)$$

$$R_3 = -R_4 = \frac{P}{4+6n}(K-K^3)$$

Where,

P = the load at a point

n = the ratio of the length of the centre to the end span, and

K= the ratio of the distance of the load P from the end of the span, to the length of the span.

$$n = \frac{16}{175}$$
$$= 0.091$$

3.2.3 Calculation of stresses:

Following stresses are calculated
1. Dead load bridge swinging,
2. Dead load bridge continuous,
3. Full line load bridge continuous,
4. Each arm as simple span for line
5. Line load on one arm, approaching on other.

3.2.4 Drum and Roller

The swing bridge is divided into three classes:
1. Rim bearing sing bridge.
2. Centre-rim bearing swing bridge.
3. Combination of the two.

The centre-bearing type requires less power to turn, has a smaller number of moving parts, is less expensive to construct and maintain, and is not so materially affected by irregular settlement of the pier. They are best adapted to short span, single-track bridges. The additional power required in turning, when compare with the centre-bearing type, is comparatively small if power is used. They are better adapted to long single-track, and all double, or four-track bridges

3.2.5 Design of section :

From the maximum and minimum stresses the section of the member are calculated.
Following sections are designed according to their required numbers:
1. Diagonal.
1. Upper chord section.
3. Lower chord section.
4. Section of post.
5. Transverse and lateral bracings.

3.2.6 Deflections:

Section should be checked for Following given deflections :

1. Dead load deflection
2. Camber deflection
3. Deflection due to temperature
4. Inelastic deflection
5. Combined deflection
6. Amount of lift

3.2.7 Operating machinery:

The operating machinery of a swing bridge involves four operations. First, turning or opening the bridge. Second, when brought back the ends must be "set up" or raised. Third, the bridge must be locked. Fourth, the rails must be aligned with those on the fixed track.

The bridge is "set up" and locked by hydraulic power, whilst the rotation of the bridge is carried out by electric power. This combined system has been selected in preference to using electric power exclusively, since it is largely used, especially in America, and is said to be simpler and to assure more certainty of operation.

3.2.8 Final result:

At last all the total weight due to each member is calculated and this estimate for load per unit length can be used for the cost estimation.

Table 1. Estimation of total weight

Member	weight
Top laterals	...
Bottom laterals	…
Intermediate bracing	…
Track	…
Stringer	…
Intermediate floor beams	…
End floor beams	…
Total	…
Total for main members	+…
Total weight on drum	…
Weight per linear foot	…
Assumed weight per linear foot	…

4. CONCLUSION

At last it is concluded that Swing Bridge is the best alternative for the short span rivers and canals and also suitable for large spans if carefully designed. It is more preferable than that of Bascule Bridge.

Accidents and many failures caused in these types of bridges are because of the improper operation and functioning and also improper designing. If during the time of construction and designing proper designing is done also if material chosen for the bridge serves all properties there is no chance of failure for a long duration.

5. ACKNOWLEDGMENTS

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Automation of Version Management and Change Propagation

V. Koti Reddy
Department of CSE,
JNTUA College of Engineering,
Anantapur, India;

Prof. A. Ananda Rao
Department of CSE
JNTUA College of Engineering,
Anantapur, India;

ABSTRACT

Software systems generally involve a number of phases and tend to evolve over a period of time. Several revisions of individual artifacts which make up the system take place during the evolution process. The revisions and refinements are captured and maintained as different versions using configuration/version management tools. A key issue in the version management of object oriented software system is classification of attributes of an artifact into two categories namely versioning and non-versioning which determines the major and minor functionalities, respectively, of the artifact. In this paper we propose an algorithm for automating the process of above classification. The results of classification are used to predict the type of change as version change or equivalent change required to be made in the related artifacts at the time of evolution due to change propagation. A semantic entity called Unified Representation of an Artifact (URA) is used for representing the artifacts in the software system. The object oriented issues like inheritance, aggregation and association, are also considered for propagating a change in the software system. The role of accessibility of attributes such as private, public and protected in version management is also considered.

Keywords: Change Propagation, Equivalent Change, Unified Representation of an Artifact, Version Change, and Version Management.

1 Introduction

Software systems are developed generally based on an iterative paradigm, where each iteration provides a successive refinement over previous iteration. Refinements in software systems are managed by maintaining different configurations of various artifacts of the systems. User requirements of software systems keep changing. This change leads to evolution of software system. As the requirements of users changes, software has to support the evolution easily. The changes in an artifact normally require corresponding changes in other dependent artifacts. Therefore there is a need to capture the evolution of related artifacts to keep the system in consistent manner. Capturing the evolution of software system is major issue in software maintenance phase. The concept of version management is used for managing the evolution of the software system.

A key issue in the version management [1][2] of object oriented software system is classification of attributes of artifacts into two categories namely versioning and non-versioning attributes. Here an attribute is used to mean an instance variable or method of a class. If a change of an artifact leads to change of other related artifacts, then it is versioning attribute, otherwise it is a non-versioning attribute. Versioning attributes determine major functionality of software system and non-versioning attributes determine minor functionality. Version of an artifact is represented in the form: “<major><minor>”. If there is a major change in the functionality of an artifact then it is said to be version changed. This is caused when there is a change in one or more of its versioning attributes. On the other hand if there is a minor change in the functionality of the artifact then it is said to be equivalent change. This is caused when there is a change in one or more of its non versioning attributes.

1.1 Introduction to URA

The Unified Representation of an Artifacts (URA) [2] is a meta model entity that represents an artifact of any type or granularity. An artifact is nothing but any logical entity of interest. Artifacts map to physical entities in different ways like classes, sets of classes, sub systems, documents, etc. Fig. 1.1 shows the structure of URA. An URA mainly comprises of three components. The first one extracts the artifact from the information system. The second component contains the information about the artifact. The third component enforces authentication mechanisms. A set of features are associated with the URA, which allows it to be classified and queried. These features can be either attributes or functionalities of artifacts. The semantic based version information set keeps track of evolution of artifacts. In addition to these, there are labeled links pointing to other URAs, which reflect the relation between the artifacts that the URAs present. A software project is represented as directed graph of URAs. The graph will evolve as changes occur in the project. An artifact in the project is represented as an URA, which is a node in the URA graph. Directed edges in the graph are labeled. The labels are the relationships between the artifacts. Changes occurring in a node are classified into two types. Changes, which create a new version and changes, which create new equivalent. In the URA graph a node is said to change in to new version, if the change affects the semantics of the node. The semantics of a node is said to have changed if there is a change in the functionality or interface of the node. If the change does not affect the node semantics, the node is said to have changed in to new equivalent. The attributes are categorized into versioning attributes and non versioning attributes. Here the attribute is used to mean a feature of an artifact. The labeled links indicate the dependencies between the nodes of the graph and need to propagate the changes. A pivot node in the graph represents the whole project. URA nodes are linked to pivot node by dependency links. Changes are propagated to this node also. The version of this node is nothing but the version of the Software system.

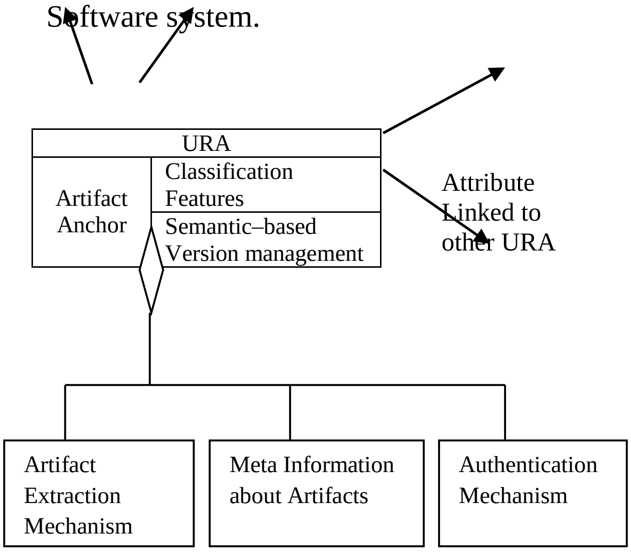


Fig. 1.1 Structure of an URA

2 Change Propagation Mechanism

In configuration management, generally whenever a change occurs in an artifact that has to be propagated to the all related artifacts. This propagation preserves the consistency of software system under consideration.

2.1 Varieties of change propagation

In object oriented technology classes are considered as basic building blocks of software system. These classes are related using various types of relationships among them such as inheritance, aggregation and association. The classes are represented as artifact in URA graph and relationship among the classes are represented as links. These links are labeled as cohesive or non-cohesive in the URA graph. In URA graph change is propagated to the related artifacts based on two values which are called as focus of change and property of a link between the artifacts i.e. cohesive or non-cohesive.

The propagations in URA graph are categorized into two categories, one is propagation of equivalent change and the other is propagation of version change. These two categories are tabulated in Tables 2.1 and 2.2 respectively. Whenever a change is propagated in the URA graph. The recommended changes are shown in the following tables.

Table 2.1: Version Propagation table

	Version Focus	
	LOW	HIGH
Cohesive link	V-Change	E-change
Non-Cohesive link	E-change	E-change/ N-change

Change propagation in case of version change of an artifact is as follows.

- If the link is cohesive and version focus is LOW then a version change (V-Change) is recommended to related URAs.
- If the link is cohesive and version focus is HIGH then an equivalent change (E-Change) is recommended to related URAs.
- If the link is Non-cohesive and version focus is LOW then an equivalent change (E-Change) is recommended to related URAs.
- If the link is Non-cohesive and version focus is HIGH then an equivalent change (E-Change) is recommended to related

URAs. If the version focus is too HIGH and cohesion of link is too low then no change is recommended.

Table 2.2: version propagation table

	Equivalent Focus	
	LOW	HIGH
Cohesive link	E-Change	E-Change
Non-Cohesive link	E-Change	N-Change

Change propagation in case of equivalent change of an artifact is as follows.

- It the link is cohesive and focus is LOW, then an equivalent change is recommended to related URAs.
- If the link is cohesive and focus is HIGH, then an equivalent change is recommended to related URAs.
- If the link is non-cohesive and focus is LOW then an equivalent change is recommended to related URAs.
- If the link is non-cohesive and the focus is high then no change (N-change) is recommended to related URAs.

2.2 Reasons for Change Propagation

Change propagation can occur because of two reasons:

- If an attribute of an artifact is changed, then change is propagated to related artifacts. Various cases of this reason have been depicted in the table 2.3
- New dependency links will be created when a new artifact is added to the system. These link directions can be to or from the new artifacts. The recommended changes of an artifact based on the direction as well as cohesiveness of the link are shown in table 2.3.

Table 2.3 New artifacts cause changes to existing artifacts.

		Direction of Link		
		To the new Artifact	From the new Artifact	Bi-Directional
Property of the link	Cohesive	E-change	V-Change	V-Change
	Non-Cohesive	N-Change	E-Change	E-Change

An artifact moves into a transient state when ever there is a change in an artifact. The artifact is in normal state before the change. Changes in an artifact will lead to chain of change propagatoin. It may also form a cycle. This leads to infinite change recomentdations. This situation is avoided by marking the states of artifacts that is already changed as transient state. In this way the states of an artifact are used in version management. The change management of an artifact has various sets of states. Only three states are considered for the sake of simplicity. These are transient, normal and replace states. There is no need to propagate the changes when ever a defective version of an artifact is replaced. Change propagation can be avoided by marking state of the replacing artifact as replace state.

3. Change Management

A class is considered as a basic entity in object oriented systems. Hence each class is treated as an artifact and denoted as a URA. Links between the URAs shows the relations between the classes such as inheritance, aggregation and association. It is easy to manage the versions through a URA graph. There are two issues of change management. These are version change and version propagation. They are addressed below. When ever a version change occur to an artifact there is a need to propagate the change to other dependent artifacts.

3.1 Version change:

Version change of software systems are of two types. One is change in version and the other one is equivalent change. If the changes in software are significant and affect the software system functionality then it is a version change. Otherwise if the changes in software are due to minor improvements and system functionality is not affect much, then it is said to be an equivalent change. Changes can also be categorized as follows. One is internal change of artifacts and other is change propagated from related artifacts. Internal change of an artifact can occur through version or non-versioning attributes. The type of change of an artifact is decided by versioning attributes or non-versioning attributes. Change can occur in two ways. One is change in attributes and the other is addition of new attributes to the artifact. If the attribute is versioning attribute then the type of the change occurring in the class is called as version change (V-change). If the attribute is non-versioning attribute then the type of the change occurring in the class is called as equivalent change (E-change).

3.2 Version Propagation

In every software system the changes of the artifact will cause changes of other related artifacts. Thus change propagation mechanism is a major issue in version management. Version change of an artifact will occur if the related artifacts having accessibility to the artifact attributes and functionality. In a class there are three types of access specifiers for an attribute namely public, private and protected. The main aspects of version propagation are focus and cdegree (degree of cohesion). The focus is with respect to change in URA. Each URA in URA graph represents an artifact of the software system. A change in URA has a value called focus [1]. The focus of change is a probability that the change does not impose similar change in other related URAs. Related URA means there exist some dependency links among corresponding artifacts of URAs.

Attribute	FOCUS
Private	HIGH
Public	LOW
Protected	If (link = Inheritance) LOW Else HIGH

The change pertaining to an attribute depending on the accessibility is tabulated in table 3. 1

Table 3.1: Focus evaluation table

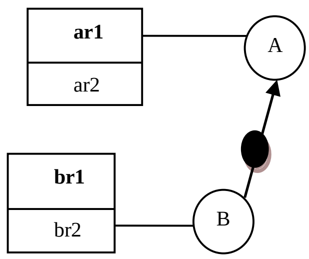
If an attribute of an artifact is private then change of that attribute may not impose changes in related artifacts. Thus the focus of private attribute is HIGH. Similarly public attribute focus is LOW. If the attribute is protected, the change may affect the related artifacts depending on link between URAs. If the link is inheritance link then focus is LOW, otherwise focus is HIGH. Cdegree of a link is the indicator of the amount of dependency that exists between the two related artifacts [1]. The value of the cdegree has a range [0,1]. The link is said to be “strong”, if the cdegree value is more than the threshold (say 0.5) and this link is called cohesive link. The link is said to be “weak” if the cdegree value is less than threshold value and link is called non-cohesive link.

3.3 Evaluation of URA graph

The fig. 3.1(a) shows the two categories of versioning and non-versioning attributes of a node. Fig. 3.1(b) shows the changes in the versioning attributes leads to new versions. Fig. 3.1(c) shows the changes in non-versioning attributes create new equivalents. Changes in the cardinality of the sets of versioning attributes create new version. This is shown in fig. 3.1(d). Fig. 3.1(e) shows the changes in the cardinality of set of the non-versioning attributes create new equivalent. Fig. 3.1(f) illustrates the changes in graph semantics due to addition and deletion of links create new versions of the nodes affected.

Change is propagated to other nodes depending on the type of the change, focus of the change and the cdegree of the links to other nodes. A summary of change propagation is as follows-

- Incase of version change, if the cdegree of the link connecting two nodes is greater than or equal to threshold value, then it is communicated as version change or version change recommendation from a node to its neighboring node. This is illustrated in fig. 3.1(g)
- Incase of version change, if the cdegree of the link connecting two nodes is lesser than threshold value, then it is communicated as equivalent change or equivalent change recommendation from a node to its neighboring node. This is illustrated in fig. 3.1(h)
- Incase of equivalent change, if the cdegree of the link connecting two nodes is greater than or equal to threshold value then it is communicated as equivalent change or equivalent change recommendation from a node to its neighboring node. This is illustrated in fig. 3.1(i).
- Incase of equivalent change, if the cdegree of the link connecting two nodes is lesser than threshold value, then it is considered as equivalent change or equivalent change recommendation from a node to its neighboring node. This is illustrated in fig. 3.1(j).



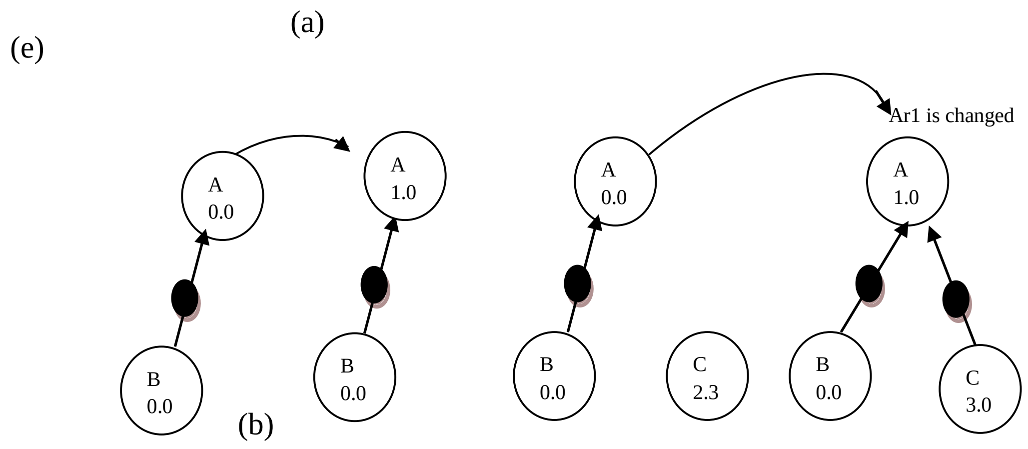
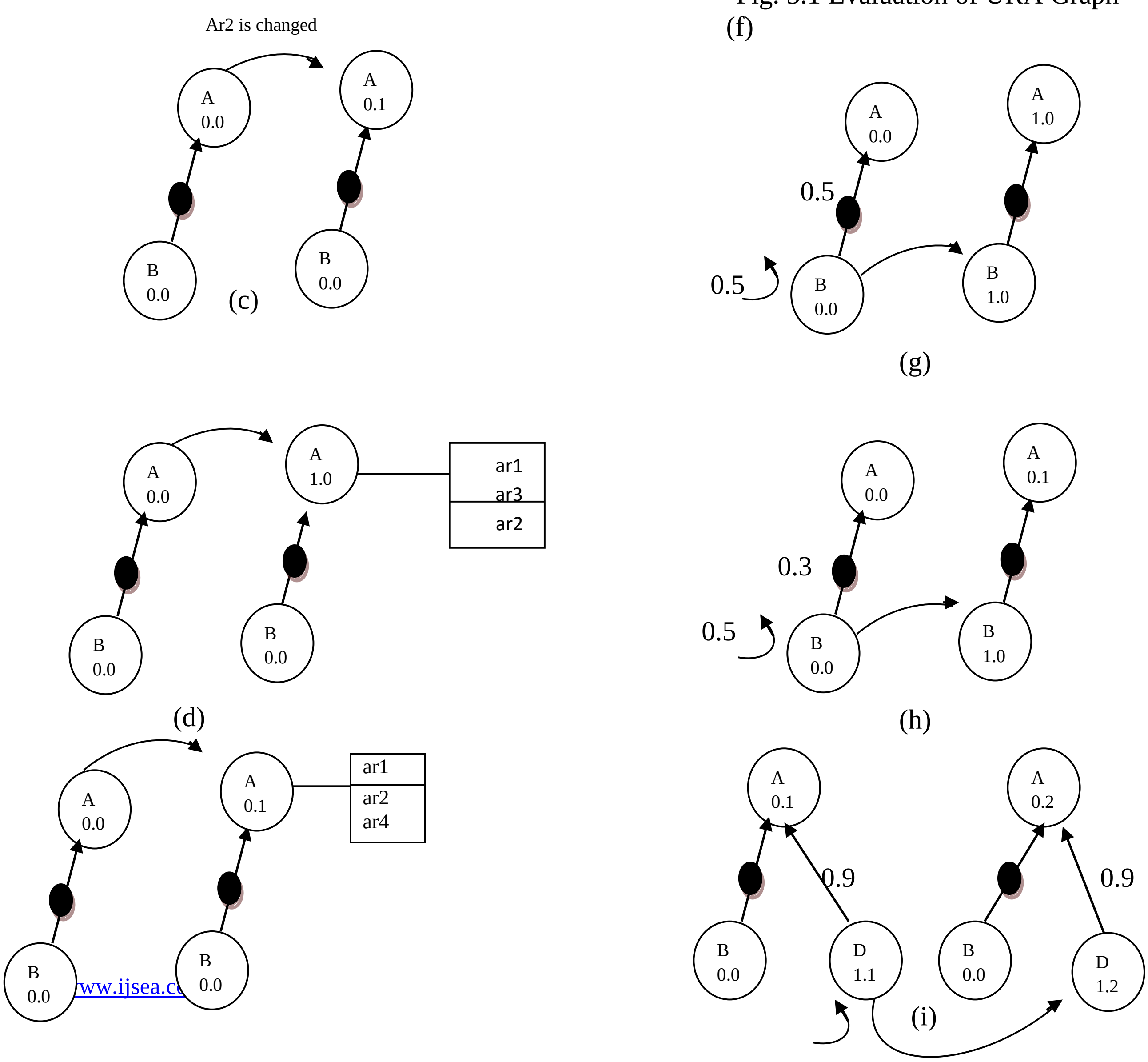
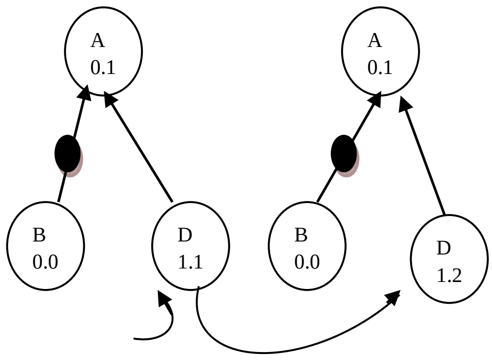


Fig. 3.1 Evaluation of URA Graph





(j)

3.4 Change Propagation *(in case of Inheritance, Aggregation and Association)*

(a) URA Graph Representation of Inheritance

The three different links between the classes in OO systems are inheritance, aggregation and association. These are mapped to URA labeled links i.e., cohesive and non-cohesive links. These mappings as well as change propagation are discussed in this subsection.

3.4.1 Inheritance: The unidirectional dependency link between the base class and derived class is called inheritance link. The changes made to base class affect the derived class. Change in a private attribute leads to change with HIGH focus. Change in a public or protected attribute leads to change with LOW focus. The changing attribute can be either versioning attribute or non-versioning attribute. Correspondingly the focus of the change will become version focus or equivalent focus. The representation of UML class diagram with inheritance structure as a URA graph is shown in 0.7 fig 3.2.

0.5

(a) Inheritance

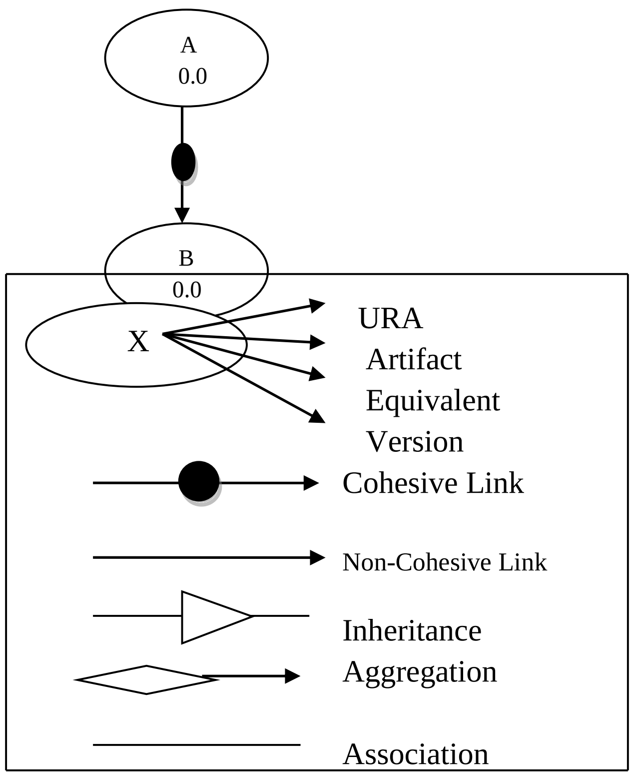
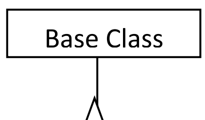


Fig. 3.2 Inheritance and URA Graph.

3.4.2 Aggregation: It is a unidirectional dependency link. Fig.3.3 shows the representation of UML class diagram with aggregation structure and its corresponding URA graph. It is a cohesive link because change made to part classes affects the whole class. Change in a private or protected



attribute leads to a change with HIGH focus. Change in a public attribute leads to a change with low focus.

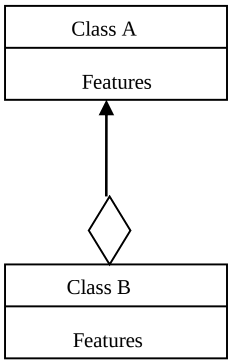
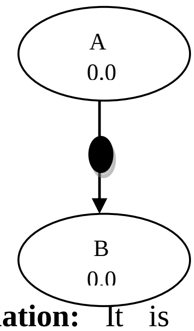


Fig. 3.3 (a) Aggregation



3.4.3 Association: It is a bidirectional dependency link in UML class diagram. It

Fig. 4.1 URA Graph Generator.

can be cohesive or non-cohesive link. The property of link can be found by using cdegree value. Fig 3.4 shows UML class diagram with association structure and its corresponding URA graph

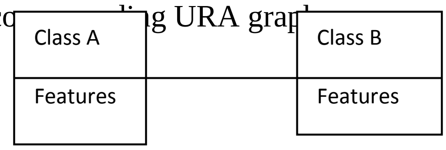


Fig. 3.4(a) Association

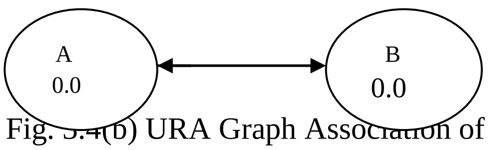


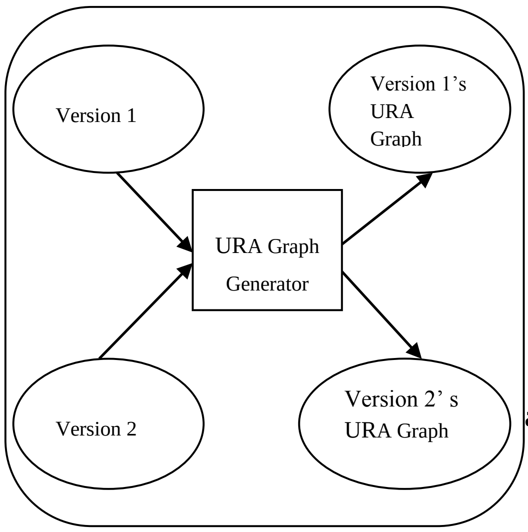
Fig. 3.4(b) URA Graph Association of Association

4. System Design

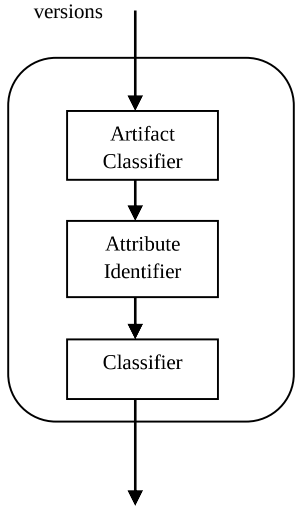
The following section explains URA graph generator, attribute classifier and change propagator.

4.1 URA Graph Generator

The Fig. 4.1 shows URA graph generator which takes two versions of software systems as input and generates their corresponding URA graphs.



ation of



4.2 Attribute Classifier

The input to attribute classifier is URA graphs of the two versions, which are generated by the URA graph generator. It gives the URA graph of the first version with its attributes classified as versioning, non-versioning or unknown. Fig. 3.2 shows the attribute classifier

4.3 Change Propagator

The input to change propagator are class (artifact) in the source version and the modified class. It generates the list of affected artifacts by using the URA Graph of the source version. Fig 4.3 shows change propagator

5 Algorithms

The following sections explains the URA Graph generation, Attribute classification and Change Propagation algorithms

URA Graph of first version with attribute classified

Fig. 4.2 Attribute Classifier

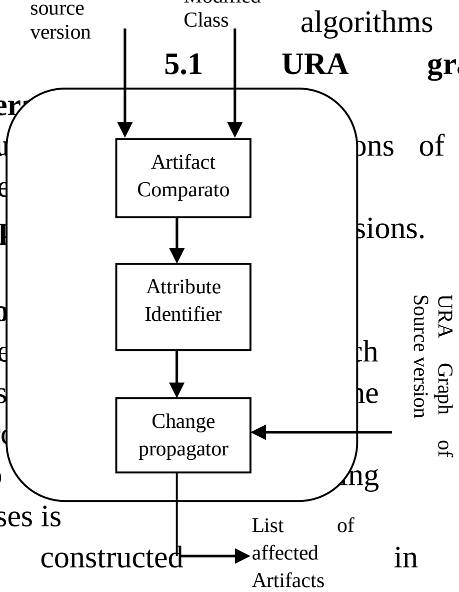


Fig. 4.3 Change Propagator

5.1 URA graph gener…

Inpu… …ons of the proje…

Out… …sions.

Algo…

Repe… …ch class… …e sourc…

Step … …ng classes is constructed in the first parse of the source. The attributes and methods are extracted for each class. This forms the URA node of this class.

Step 2: The links between the classes are determined in the second parse of the source.

5.2 Attribute classification

Input: URA graphs of two versions, generated by the URA graph generator.

Output: URA graph of first version, with the attributes of the artifacts classified as versioning, non-versioning and unknown.

Algorithm:

Step 1: Consider a particular class from the two versions of system.

Step 2: Determine whether the change is version change or an equivalent change.

Step 3: Determine the attributes, which caused the above change.
Step 4: Accordingly classify the attributes as versioning and non-versioning attributes.

5.3 Change Propagation:

Input: A class in the source version and its modified form and URA graph of the source version.
Output: List of effected classes (Version changed classes and equivalent changed classes).
Algorithm:
Step 1: compare the input class of the source version and its modified form.
Step 2: Identify the attributes, which were changed.
Step 3: Identify whether the change is a version change or an equivalent change based on classification status of the variables that were changed.
Step 4: Accordingly mark the class as version changed or equivalent changed class.
Step 5: Propagate the direct and indirect changes using the URA graph and mark the effected classes accordingly.

6 Results and conclusions

The tool was tested using professional software by name "Restricted Focus Viewer". Restricted Focus Viewer (RFV) 1.1, RFV 2.0 and RFV 2.1 are the three different versions considered for the testing purpose. There is a version change between RFV 1.1 and RFV 2.1. There is an equivalent change between RFV 2.0 and RFV 2.1.

6.1 Results

The results are illustrated by the following screen shots of the output. The fig. 6.1 shows the main screen which contains the automated attribute classifier and Change propagator.

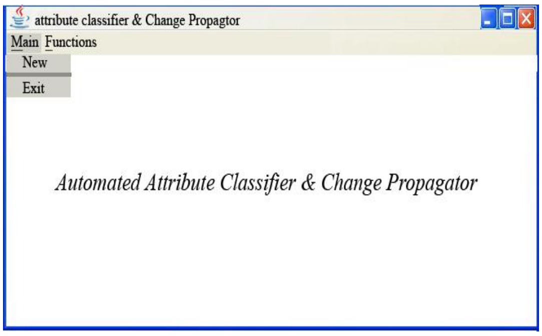


Fig. 6.1: Main Screen

Fig. 6.2 shows the open dialog to select source directory of the version to construct the pivot graph.

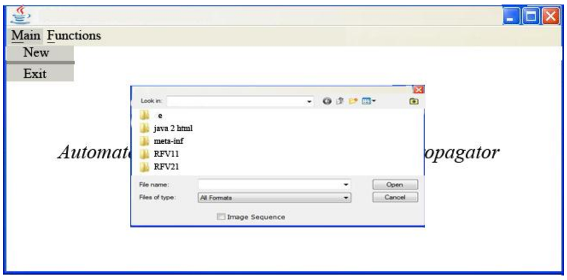


Fig. 6.2: Open Dialog

The attributes of RFV_FOCUS_Window class are classified and the classification results are shown in fig. 6.3

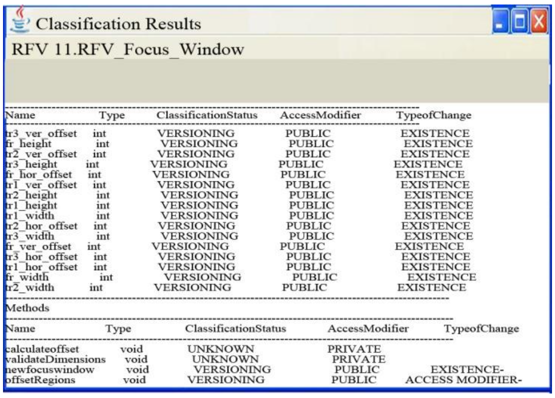


Fig. 6.3 Classification Results

Figure 5.4 Shows the results of propagation function on RFV_Focus_Window classes.

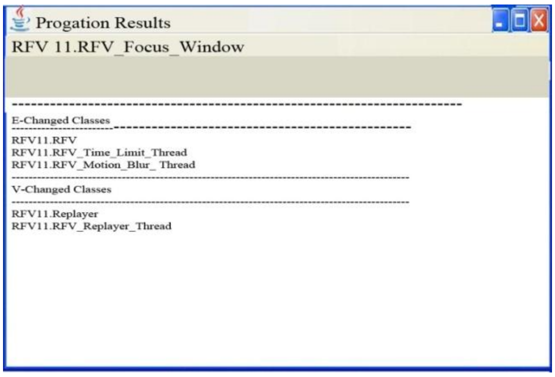


Fig. 6.4 Propagation Results

6.2Conclusions

This process of automation provides a method for finding the versioning and non-versioning attributes of an artifact. This project has been used to collect and analyze the data for a number of applications. Improved measures for calculation of cdegree (cohesion degree) may be adopted. The effect of changes made in an artifact can be determined to a higher degree of precession. This may be achieved by slight improvement in the strategy used for keeping track of the links of an artifact.

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Optical Properties of PolyvinylPyrrolidone and Carboxymethyl Chitosan films

A.I. Aboud
Department of Physics
Faculty of Science, Cairo University
Giza, Egypt

K.H. Mahmoud
Department of Physics
Faculty of Science, Cairo University
Giza, Egypt

Abstract

Polyvinyl Pyrrolidone (PVP), Carboxymethyl Chitosan (CMCH) films and their 50/50(wt/wt %)(PVP/CMCH) blend sample were prepared using casting technique. X-ray diffraction technique revealed that, the prepared samples were miscible. The optical absorption was recorded at room temperature in the wavelength range of 190-800 nm. Fitting of absorbance data proved that the transition is indirect allowed with optical band gap, E_{opt}, of 3.60 eV for pure PVP film and 3.94eVfor pure CMCH. The blend sample containing 50wt% PVP has an optical band gapand band tail with 3.80and 0.40eV.Variation of optical band gap and band tail values under blending of pure polymers gives an indication of structural modification of blends. Optical parameters such as refractive index, complex dielectric constant and color parameters were studied.

Keywords: PVP, CMCH, Optical parameters, Urbach energy, Band gap

1. Introduction

One of the most important techniques in polymer science is blending. It is an attractive, simple, and inexpensive technique for producing new polymeric material with tailored performance without completely synthesis of new materials [1].

Polyvinyl pyrrolidone (PVP) is an amorphous water soluble, inert, nontoxic, conjugated polymer. It has good environmental stability, easy process situation, excellent transparency, excellent biocompatibility and surface activity. It has several pharmaceutical applications [2] and has been used as lubricant and as a main component of temporary skin covers or wound dressings [3]. In addition, PVP has the ability for complex formation through hydrogen bond between its carbonyl group and hydroxyl containing polymers such as carboxymethyl chitosan and polyvinyl alcohol [4,5].

Carboxymethyl chitosan (CMCH) is water-soluble polysaccharide, has some unique properties such as high viscosity, large hydrodynamic volume, low toxicity, biocompatibility, antibacterial properties, antitumor activities and film and gel-forming capabilities, it is also has several applications, e.g., production of super absorbents, chelating agents, and bio-sorbents for wastewater treatment [6-8].CMCH films also are usually used as wound dressing (i.e, artificial skin),packaging films and coatings[6, 9].

The aim of the present work is to achieve blends with enhanced optical properties in order to use them in industrial applications such as, displays, electronic and optoelectronic devices.

2. **Experimental**

2.1 **Samples preparation**

PVP with average FW approximately 40000 was supplied by Fisher Scientific, Fisher Chemicals, USA. Carboxymethyl Chitosan with molecular weight $(249.1)_n$ was supplied by Santa Cruz biotechnology, Germany. The solution method was used to obtain film samples. Weighed amounts of PVP and CMCH were dissolved in double distilled water at room temperature using a magnetic stirrer. Solutions of the two polymers were mixed together with different weight percentages to give the blend system xPVP-(100-x) CMCH; (x= 100, 50,0 wt %) and samples are designated as P100,P50 and P0 respectively. Films of suitable thickness (~ 75µm) were casted onto stainless steel Petri dishes, and then dried in an ovenat50^{o}C for about 24 hours until solvent was completely evaporated.

2.2.**Spectroscopic measurements**

X-ray diffraction analysis of the samples is carried out with a Bruker AXS D8 Discover diffractometer with GADDS (General Area Detector Diffraction System) operating with a Cu-K_α radiation source filtered with a graphite monochromator (λ=1.5406 Å). The absorption measurements were performed using Evolution E220 spectrophotometer over the range of 190-800 nm. The color parameters and color difference data were calculated using the CIEL*u*v* system

3. **Results and discussion**

3.1 **X-Ray diffraction profiles**

X-ray diffraction (XRD) was performed to discover the amorphous and crystalline portions of PVP, CMCH and their blend sample. Fig.1 shows the typical XRD pattern of PVP, CMCH and P50 blend sample.

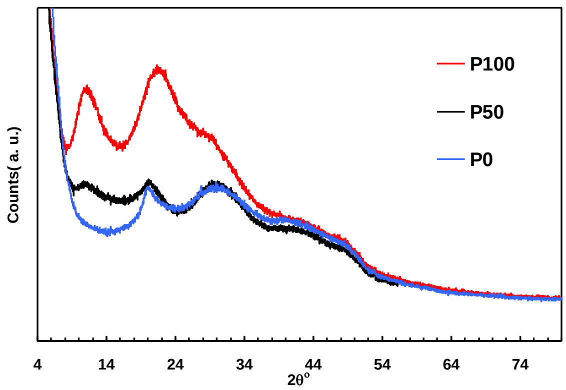


Fig.1 X-ray diffraction profiles of xPVP - (100-x) CMCH polymer blend system.

The diffraction patterns showed that there is no sharp or narrow peak for CMCH and PVP indicating an amorphous nature. For the pure PVP (P100 sample), there are two peaks at around 2θ=11.3° and 21.69° with high intensity. The CMCH pure polymer (Po sample) exhibits two peaks at 20.24° and 30.28° and this is in a good agreement with literature [10]. For blend P50 blend sample, three peaks with small intensity appeared around 2θ=11.4°, 20.59° and 29.8°.From these observations one can conclude that, there is a certain level of miscibility between PVP and CMCH[11].

3.2 **Optical properties**

3.2.1 **Optical absorbance spectra**

Figure 2 shows the absorbance spectrum of xPVP - (100-x) CMCH polymer blend system from190-800 nm. The spectrum of Pure PVP (P100 sample) shows a shoulder like band at 206 nm and a band at 230 nm.

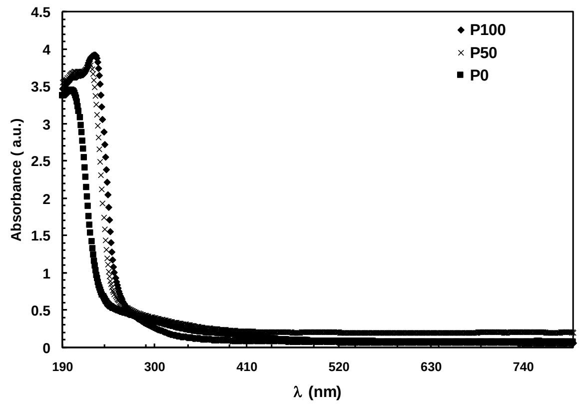


Fig.2 Absorbance spectra of xPVP - (100-x) CMCH polymer blend system

The observed shoulder and band may be attributed to π→π*and n →π* electronic transitions respectively. In case of P50 sample the position of shoulder is approximately unchanged; on the other hand this shoulder located at 202 nm for CMCH sample (P0 sample).For P50 sample, a blue shift occurs for the band and this band disappears for P0 sample. It is observed that CMCH has lower absorbance values than other samples and PVP has the largest absorbance among employed samples in the wavelength range (190-300 nm). The P50 sample has highest absorbance in visible region than other samples. The change in absorbance with composition is an indication of bonding between PVP and CMCH polymers .This bonding can occur through carbonyl group of PVP and hydroxyl group of CMCH [4,12].

3.2.2. **Optical parameters**

The absorption coefficient, α (ν) below and near the absorption edge is related to absorbance through the relation:

$$\boldsymbol{\alpha(\nu)} = \frac{\boldsymbol{log(\frac{1}{T})}}{\boldsymbol{t}} \quad (1)$$

Where T is transmittance and t is the film thickness.

The observed shift in the fundamental absorption edge of UV-visible spectral range can be related to the optical band gap by Tauc's expression [13, 14]:

$$\alpha(\nu)E = C(E - E_g)^q \quad (2)$$

where C is constant called band tailing parameter; E is the energy of incident photon ;E_g is the optical band gap energy and q is the index such that q = 2, 3, 1/2, 1/3,that corresponds to indirect allowed, indirect forbidden, direct allowed and direct forbidden transitions, respectively.

Eq.2 as a function of wavelength (λ) can be written as[15]:

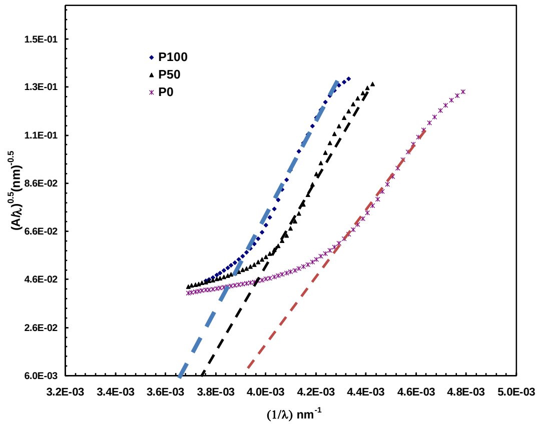
(3)

Where λ_g, is the wavelength corresponding to the optical band gap, and c is velocity of light. Using Eq.1, Eq.3 can be rewritten as:

$$\frac{A(\lambda)}{\lambda} = S_1\left(\frac{1}{\lambda} - \frac{1}{\lambda_g}\right)^q + S_2 \quad (4)$$

Where S_1 and S_2 are constants. The parameter λ_g is obtained by extrapolating the linear portions of the $(\frac{A}{\lambda})^{1/q}\ vs\ 1/\lambda$ curve at $(\frac{A}{\lambda})^{1/q} = 0$.

It was observed that the best fitting occurs for q=2 and this corresponds to indirect allowed transition (Fig.3).



ASF plots of xPVP - (100-x) CMCH polymer blend system

It is observed that the optical energy gap values of blend sample is higher than that of PVP and lower than that of CMCH(Table 1).

The variation of band gap for blend is attributed to the structural and chemical bonds formation and this may suggest that there is a certain degree of miscibility in the blend due to the interaction between carbonyl groups or pyridine ring of PVP and hydroxyl groups of CMCH

Table1. Values of optical band gap (E_{opt}),Urbach energy (E_e), high wavelength refractive index (n_o) and number of carbon atoms (M) per carbonaceous cluster for xPVP- (100-x) CMCH polymer blend system

polymers, respectively [16].Further, the values

Blend number	E_{opt}(eV)	E_e (eV)	n_o	M
P100	3.60	0.31	1.41	~91
P50	3.80	0.40	1.70	~81
P0	3.94	0.63	1.44	~76

of optical band gap can be correlated to the number of carbon atoms per molecule through the expression [17]

$$M = (\frac{34.3}{E_g})^2$$

Where M is the number of carbon atoms in carbonaceous cluster. The values of M for PVP and CMCH are about 91, 76 respectively (Table 2). For blend sample the value of M is between those of homopolymers and this can be correlated to the increased conjugation in monomer units of PVP and CMCH matrices after blending [18].

The band tail of localized states as stated by Urbach can be written as [19]

$$\alpha(\nu) = Fe^{\frac{h\nu}{E_e}} \qquad (6)$$

The width of the band tails (E_e) associated with valence band and conduction bands was believed to be originated from the same physical origin [14]. In terms of absorbance Eq.6 can be written as:

$$A(\lambda) = De^{\frac{hc}{\lambda E_e}} \qquad (7)$$

Where *D* is constant (=Ft/2.303). Obtaining the slope of linear regions of ln (*A*) vs. 1/λ curves (Fig.4), the (E_e) values were calculated (Table 2).

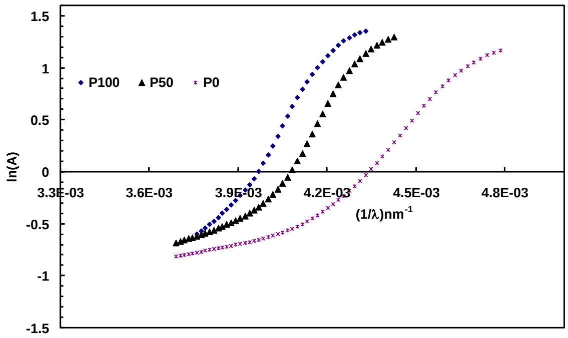


Fig.4 Plots of ln (A) vs. (1/λ) for xPVP - (100-x) CMCH polymer blend system

It is noted that the P0 sample has the largest tail width (E_e = 0.63eV), and P100 sample has the lowest value (0.31eV). For blend sample the value of tail width is between these values. The tail width gives an indication about disorder in samples and it's variation with composition could be attributed to miscibility between homopolymers. We also conclude that the blending process produces compounds with modified structural and optical properties.

3.2.3. **Refractive index dispersion**

The values of refractive index n and extinction coefficient k have been calculated using the theory of reflectivity of light [20, 21]

$$n = -\frac{(R+1)}{(R-1)} \pm 2\sqrt{\frac{1-R}{1+k^2} + (\frac{R+1}{R-1})^2} \qquad (8)$$

where k= αλ/4π is the extinction coefficient of the material. The dispersion of refractive for homopolymers and their blends is shown in Fig.5.

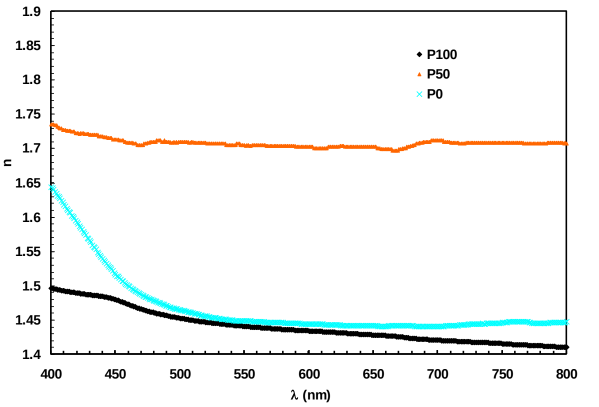


Fig.5 Variation of refractive index (n) with wavelength(λ) for xPVP - (100-x) CMCH polymer blend system

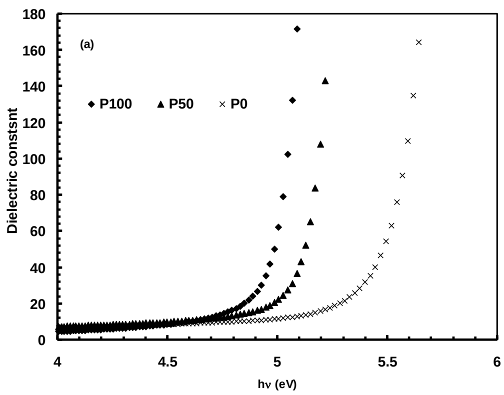
It is clear that the P50 blend sample has largest refractive index among the employed samples in the wavelength range 539-800 nm and this can be attributed to the reduction in free volume in the polymer sample as a result of blending [22].

3.2.4. **Dielectric function**

The real and imaginary parts of the complex dielectric function are related to the refractive index through the following expressions [23]

$$\varepsilon'(\lambda) = n^2(\lambda) - k^2(\lambda) \quad (9)$$

$$\varepsilon''(\lambda) = 2n(\lambda)k(\lambda) \quad (10)$$



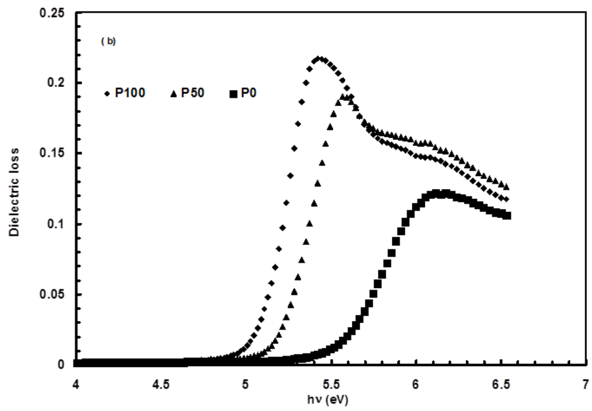


Fig.6 Plots of (a) dielectric constant , (b) dielectric loss versus photon energy (hν)for xPVP - (100-x) CMCH polymer blend system

A relaxation peak is observed in ε'' spectra at certain energies (larger than optical band gap values) as shown in (Fig. 6(a, b)).The dielectric constant and loss for P100 sample has larger values than other samples. The modification for pure polymers due to blending occurs via interaction through some functional groups such as carbonyl and hydroxyl groups on both polymers [16] and this can enhance the polarization processes in the samples and affect the dielectric parameters.

3.3.5. **Color study**

Tristimulus curves (Fig.7) show two peaks at about 560nm (higher intensity) and 470nm (lower intensity). Also it is observed that Y_t(max) varies with composition and P100 sample has higher (Y_t) values over all wavelength range for all samples.

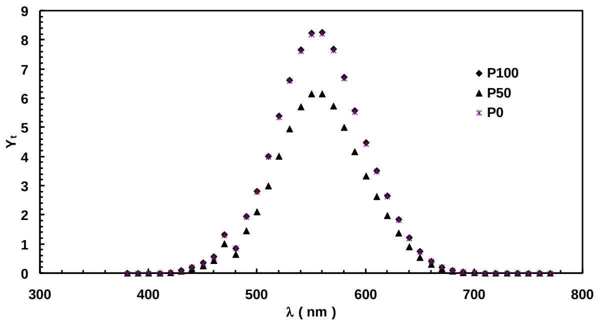


Fig.7 Tristimulus transmittance of xPVP - (100-x) CMCH polymer blend system

The color parameters L*, U*, V*, h_{ue}, W, Y_e [24] and color difference data, ΔL*, ΔU*, ΔV*, ΔC*, and ΔE between blend samples and Pure PVP sample is shown in Table 2. It is observed that the P100 sample is lighter than all other samples. Also the P50 sample is greener, bluer and brighter than other samples. Also it has the highest total color difference value among all employed samples. The observed changes in the color parameters for polymer blend sample maybe due to the formation of new color centers.

Table 2. Color parameters for xPVP- (100-x) CMCH polymer blend system

Blend number	L*	U*	V*	C*	ΔL*	ΔU*	ΔV*	ΔC*	ΔE	h_{ue}	W	Y_e
P100	93.37	0.66	2.78	2.86	-----	------	-----	-----	----	76.62	-1002.56	0.03
P50	83.19	0.37	0.94	1.00	-10.18	-0.29	-1.84	-1.86	10.34	68.79	-747.88	0.01
P0	93.06	0.38	6.13	6.15	-0.31	-0.28	3.35	3.29	3.37	86.48	-994.30	0.06

4. Conclusions

PVP/CMCH blend system has been prepared by casting technique. XRD technique revealed that the prepared blends are miscible. Optical band gap, band tail width and refractive index are remarkably influenced by blending.The variation of optical and color parameters enables us to use these samples inelectronic and optoelectronic devices.

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