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EXTRACTING A 3D REALIZABLE LINE DRAWING OBJECT  
FROM A SET OF CROSSING LINES

Ms. Supaporn Bunrit

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for the Degree of Doctor of Philosophy Program in Computer Science

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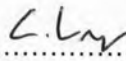
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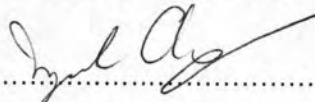
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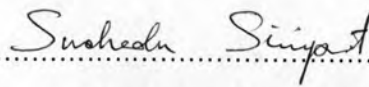
  
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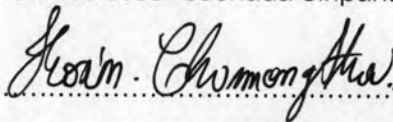
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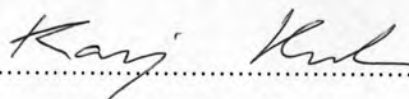
  
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สุภาพร บุญฤทธิ์ : การดึงวัตถุสามมิติที่เป็นไปได้จากชุดของเส้นที่ตัดกัน (EXTRACTING A 3D REALIZABLE LINE DRAWING OBJECT FROM A SET OF CROSSING LINES)

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งานวิจัยนี้ศึกษาแง่มุมใหม่ของปัญหาความเหมือนจริงของสามมิติ กำหนดให้มีวัตถุเหมือนจริงของสามมิติซ่อนอยู่ในชุดของเส้นที่ตัดกัน ระบุและดึงวัตถุสามมิติออกมาจากเส้นเหล่านั้น วิทยานิพนธ์นี้นำเสนอ ขั้นตอนวิธีแบบใช้กฎในการระบุและดึงวัตถุเหมือนจริงของสามมิติจากชุดของเส้นที่ตัดกัน ขั้นตอนวิธีที่นำเสนอมีประโยชน์และสามารถประยุกต์ใช้เพื่อให้ได้วัตถุสามมิติแบบ โครงลวด โดยตรงจากภาพสองมิติที่ให้มา กฎต่างๆ ที่นำเสนอสร้างขึ้นมาจากการวิจัยและการศึกษาคุณลักษณะของวัตถุเหมือนจริงในสามมิติ ขั้นตอนวิธีที่นำเสนอประกอบด้วยห้าขั้นตอนหลัก ในขั้นตอนแรก จุดเชื่อมหลักและเส้นหลักถูกระบุออกมาเป็นกลุ่มของตัวแทนของหน้าหลักของวัตถุเหมือนจริงของสามมิติ ตัวแทนของหน้าหลักถูกตรวจสอบเพื่อเป็นหน้าหลักที่แท้จริงในขั้นตอนที่สอง โดยใช้กฎในกลุ่มแรก ในขั้นตอนที่สาม จุดเชื่อมที่จำเป็นและเส้นที่จำเป็นถูกระบุเป็นหน้าที่จำเป็นที่เป็นไปได้ กฎในกลุ่มที่สองจึงนำมาใช้ในขั้นตอนที่สี่เพื่อตรวจสอบหน้าที่จำเป็นที่เป็นไปได้ไปเป็นหน้าที่จริงที่จำเป็น เส้นตรงที่ยังมีปัญหาก็ถูกตรวจสอบ โดยกฎสุดท้ายในขั้นตอนที่ห้า เส้นตรงที่ยังไม่ได้ใช้ก็จะนำมาพิจารณาก่อนที่วัตถุเหมือนของสามมิติที่ระบุจะถูกดึงออกมา ขั้นตอนวิธีที่นำเสนอนำไปใช้กับภาพจากการวาดเส้นแบบมีหลายหน้าที่ได้มาจากวิทยานิพนธ์ของวาร์เลย์ จากการทดลอง ขั้นตอนวิธีที่ใช้สามารถดึงเส้นและจุดที่เกี่ยวข้องทั้งหมดออกมาได้ถูกต้องถึง 94.68 เปอร์เซ็นต์ ความซับซ้อนของเวลาที่ใช้ของขั้นตอนวิธีที่เสนอคือ  $O(mn)$  เมื่อ  $n$  คือ จำนวนของจุดตัดเริ่มต้นที่นับได้และ  $m$  คือจำนวนของเส้นตรง

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ลายมือชื่อนิสิติ..... สุภาพร บุญฤทธิ์  
ลายมือชื่ออาจารย์ที่ปรึกษา..... C. Lmr  
ลายมือชื่ออาจารย์ที่ปรึกษาร่วม.....

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KEY WORD: LINE DRAWING / 3D REALIZABILITY / RULE-BASED APPROACH.

SUPAPORN BUNRIT: EXTRACTING A 3D REALIZABLE LINE DRAWING OBJECT FROM A SET OF CROSSING LINES. THESIS ADVISOR: PROF. CHIDCHANOK LURSINSAP, Ph.D., THESIS COADVISOR: NAGUL COOHAROJANANONE, Ph.D., 108 pp. ISBN 974-14-3427-8.

A new aspect of 3D realizability problem is studied. Given a 3D realizable object hidden under crossing lines, such lines in realizable object will be identified and extracted. In this dissertation, a rule-based approach algorithm is proposed to identify and extract a 3D realizable object from a given set of crossing lines. The proposed algorithm will be beneficial and applicable to obtain a 3D object in forms of a wired frame directly from its given 2D image. All the proposed rules are generated based on researching and studying characteristics of 3D realizable objects. The proposed algorithm consists of five main processes. In the first process, the significant junctions and significant segments are identified which result in a set of significant faces candidates of a 3D realizable object. The significant faces candidates are verified as the real significant faces in the second process using the first set of rules. In the third process, the essential junctions and essential segments are identified to be the potential essential faces. The second set of rules is applied in the forth process to verify the potential essential faces as the real essential faces. The remaining problem lines are verified by the final rule in the fifth process. The unused lines will be also considered before the identified 3D realizable object is extracted. The proposed algorithm is applied to 169 polyhedral line drawing images obtained from Varley's thesis. From the experiment, the algorithm correctly extracted all the relevant line segments and points up to 94.68 percent. The time complexity of the proposed algorithm is  $O(mn)$ , where  $n$  is a number of initial crossing points counted and  $m$  is a number of lines.

Department: Mathematics  
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Student's Signature.....*Supaporn Bunrit*.....  
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