

Univerzitet u Novom Sadu  
FAKULTET TEHNIČKIH NAUKA  
Proizvodno mašinstvo  
Predmet: RE I CAQ

# ***CAD-INSPEKCIJA***

# CAD-inspekcija – uvodne napomene

Razvoj i primena CAD-modela u inženjerskim oblastima implicirala je razvoj metoda za iskorišćavanjem najpre određenih parametara, a zatim i ukupnih CAD modela za potrebe kontrole, tj. verifikacije i inspekcije.

- Preduslov za dobar inženjerski proces jeste sprovođenje kontrole/verifikacije tokom njegove realizacije.
- Jedan od savremenih pristupa kontrole je **računarom podržana inspekcija (eng. computer-aided inspection CAI)**.
- **CAI podrazumeva komparaciju (poređenje) oblaka tačaka u odnosu na CAD model.**

# CAD-inspekcija – uvodne napomene

- **Specifičan oblik CAI je CAD-inspekcija.**
- Rezultat ovakve analize se dobija u nekoliko oblika – od numeričkih podataka, do grafičkih u vidu **mapa u boji (ili kolor mapa) kod koje svaka boja predstavlja određeni nivo odstupanja.**
- Ova metoda je danas prihvaćena kao brz, efikasan i kredibilan način provere kvaliteta izrade delova različitim tehnologijama (3D štampa, rezanje, plastično deformisanje, oblikovanje plastike itd.)

# CAD-inspekcija – definicije i terminologija

*CAD*-inspekcija podrazumeva korišćenje *CAD*-modela proizvoda, odnosno njegovih parametara, sa ciljem provere geometrijskih i dimenzionalnih odstupanja izrađenog dela ili virtuelnog modela (kreiranog na bazi rezultata 3D digitalizacije).

*CAD*-inspekcija je, prateći razvoj *CAD* modeliranja, najpre bila zasnovana na 2D podacima, da bi se zatim sa pojavom solid modela razvila i 3D *CAD*-inspekcija, danas poznata i pod nazivom “*CAD-to-part*” inspekcija, koja podrazumeva proveru odstupanja geometrije realnog proizvoda (na bazi njegovog digitalizovanog modela) od nominalne geometrije, definisane *CAD* modelom.

# CAD-inspekcija – definicije i terminologija

Termini-sinonimi koji se upotrebljavaju za opis ovog procesa, sa manjim ili većim modifikacijama procesa su:

- **Brza 3D inspekcija (eng. Rapid 3D Inspection)**
- **Računrom podržana verifikacija (eng. computer-aided verification CAV)**
- **3D color comparison-to-CAD**
- **i dr.**

Zahvaljujući zasnovanosti na CAD-modelu, ova vrsta inspekcije je najpoznatija pod nazivom ***CAD-inspekcija***.

# CAD-inspekcija - metodologija

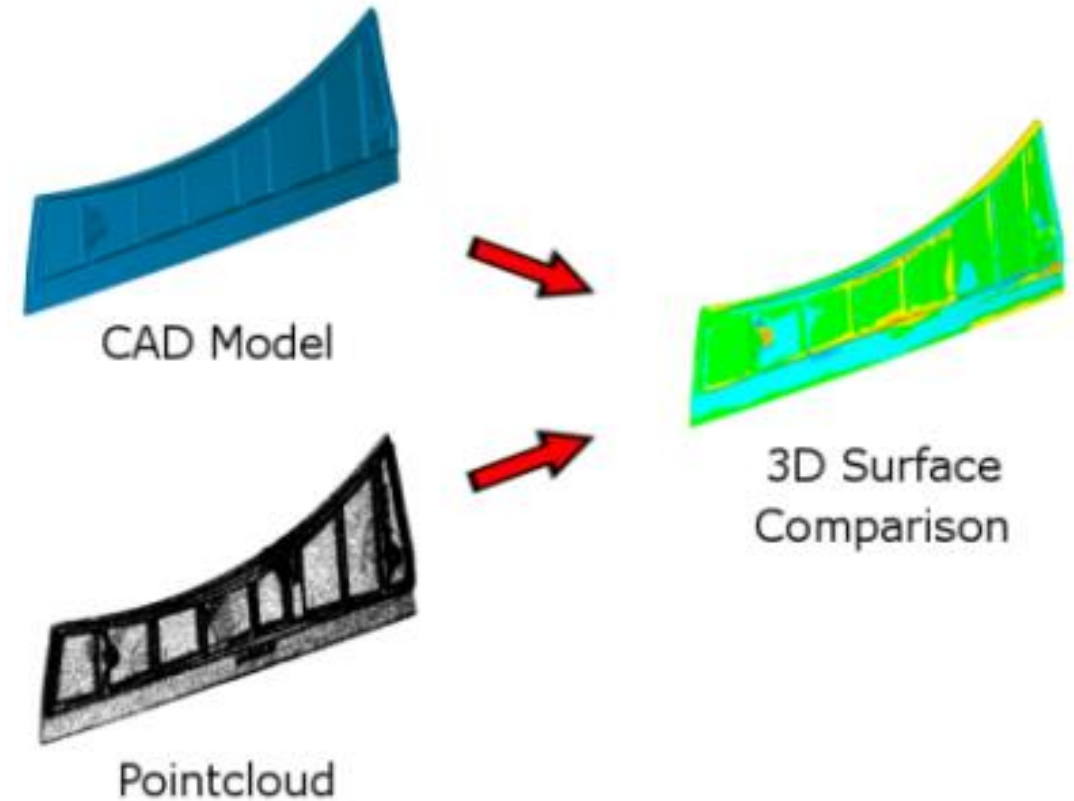
Dva osnovna segmenta *CAD*-inspekcije su:

- **3D-digitalizacija** (dominantno hardverski proces) i
- **provera odstupanja** (dominantno softverski proces).

# CAD-inspekcija - metodologija

**CAD inspekcija** predstavlja metodu koja poređi geometriju proizvedenog dela (rezultat 3D digitalizacije) u odnosu na referentnu geometriju (originalni CAD model) i podrazumeva sledeće korake:

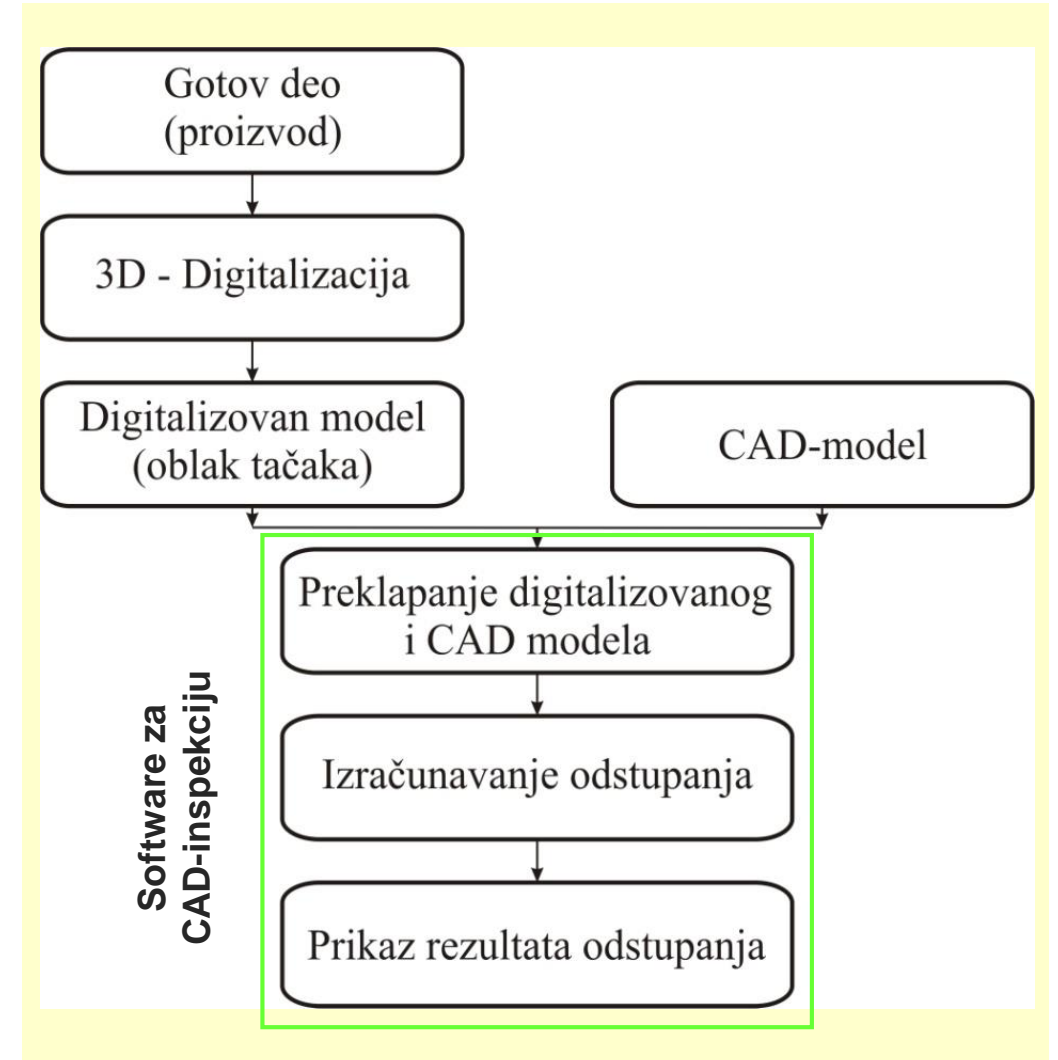
1. **3D digitalizaciju**
2. **Generisanje površinskog modela – opciono**
3. **Komparaciju sa referentnim CAD modelom**



# CAD-inspekcija - metodologija

## Procedura provere odstupanja

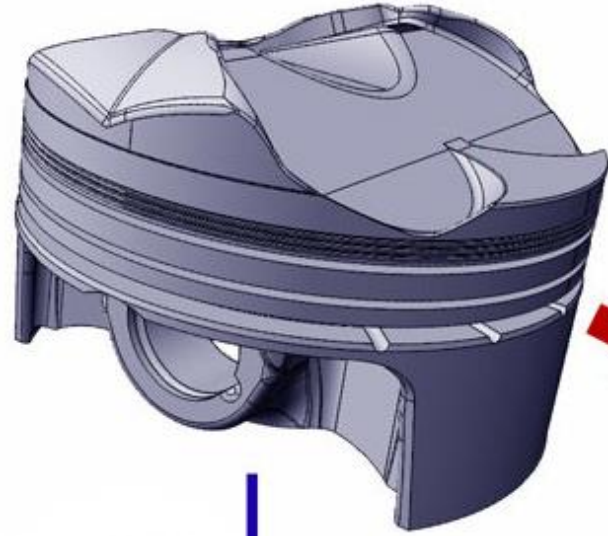
- izrađen deo se digitalizuje nekom od metoda 3D-digitalizacije;
- 3D digitalizovani model (*oblak tačaka*) unosi se u neki od specijalizovanih softvera za CAD-inspekciju, zajedno sa referentnim CAD-modelom;
- sledi orijentisanje digitalizovanog modela prema CAD-modelu u cilju njihovog međusobnog preklapanja;
- potom se vrši izračunavanje nivoa odstupanja digitalizovanog modela od CAD-modela;
- prikaz rezultata odstupanja (mogu se dobiti i u grafičkom obliku radi lakše preglednosti).



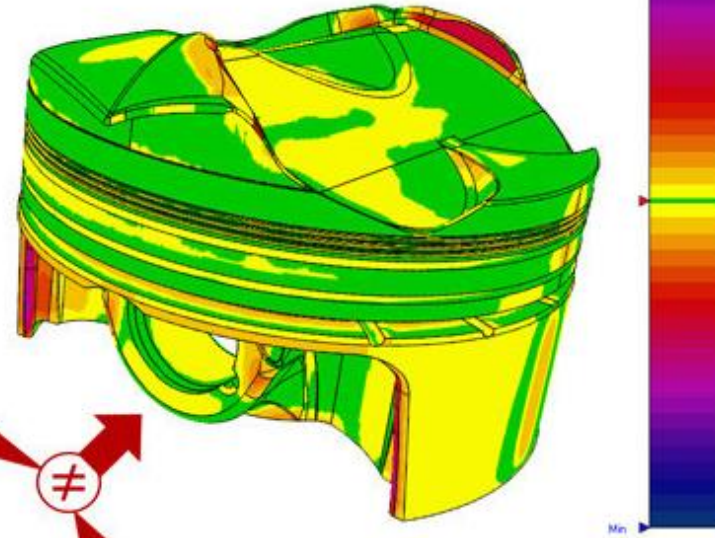
Algoritamski prikaz toka procesa



CAD file  
- Ideal Design



Comparison CAD / CT Scan  
- Visualisation of dimensional defects



3D Computed  
Tomography

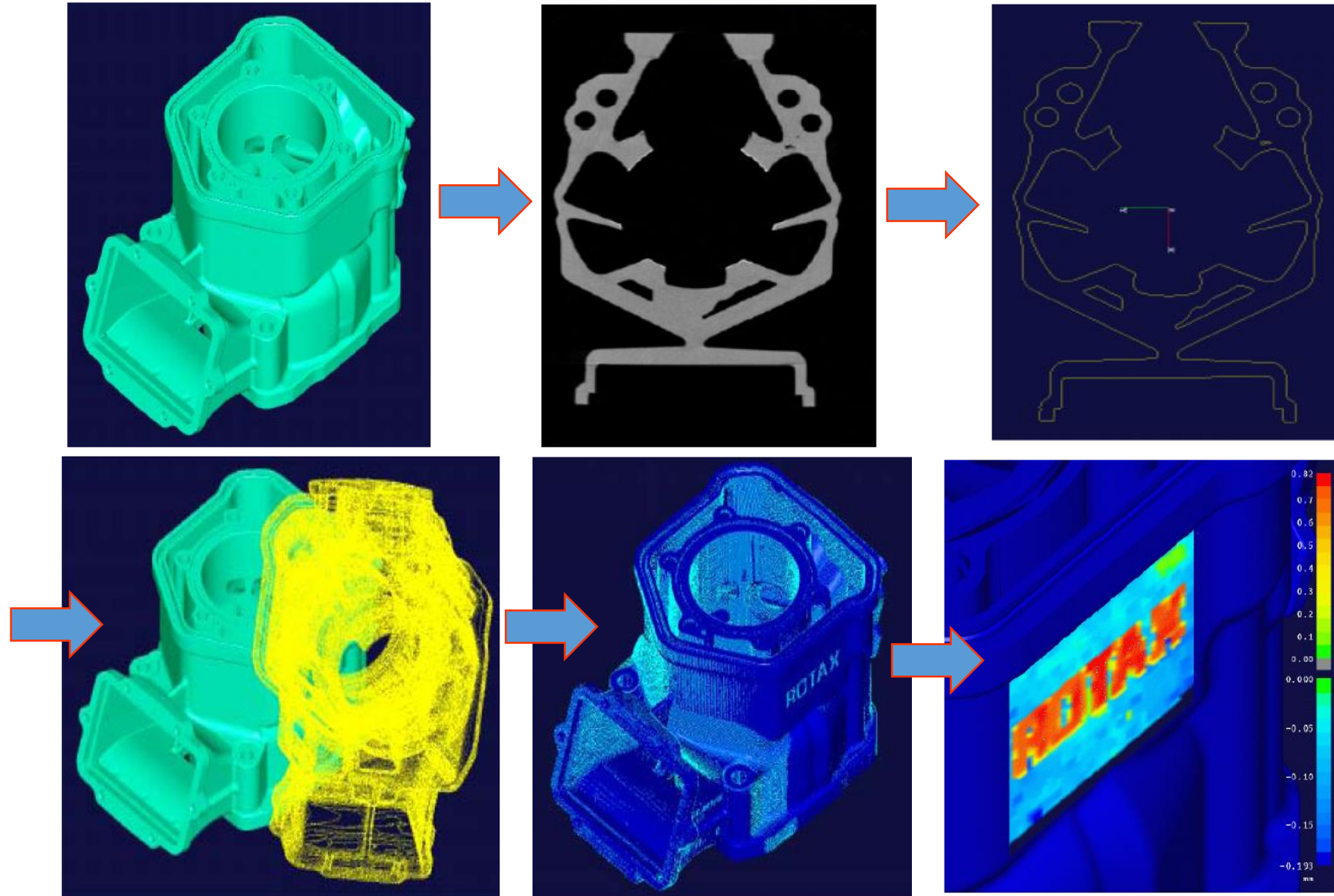


Real part

3D data  
- Dimensional measurements

# CAD-inspekcija - metodologija

Procedura provere odstupanja - primer



# Primeri primene:



## Qualify Report

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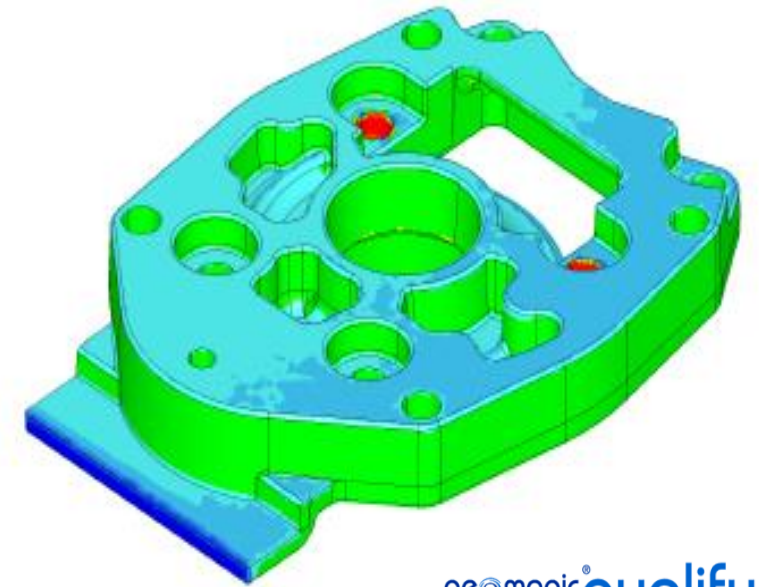
Author: Kevin Scofield

Client: ACME Manufacturing

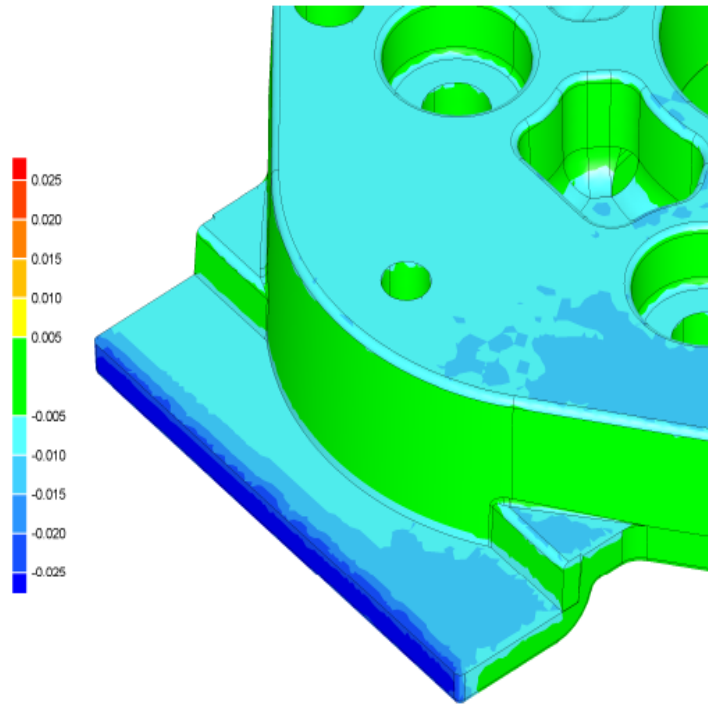
Part: No. GP-5634 (AL 7075)

Test: Injector\_plate-SCAN

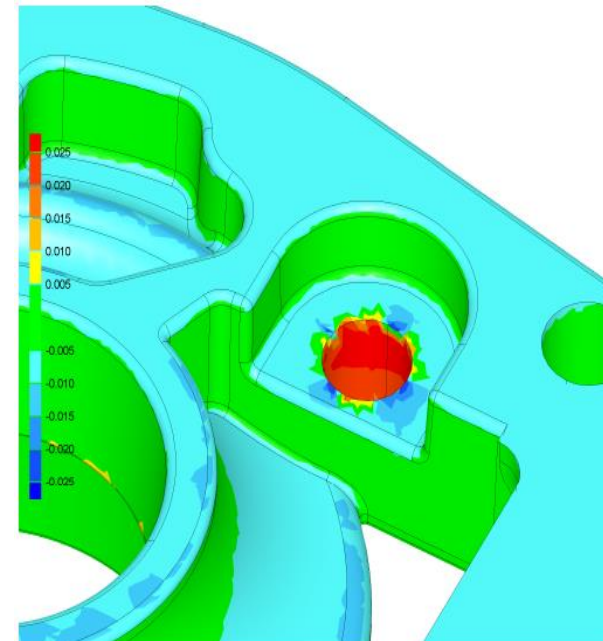
8/13/2002

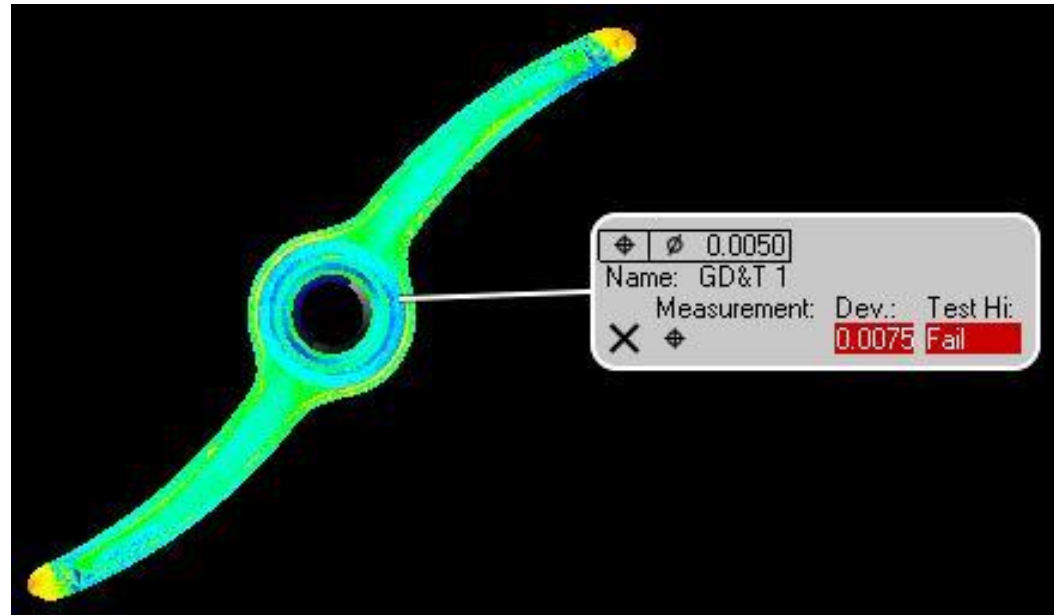
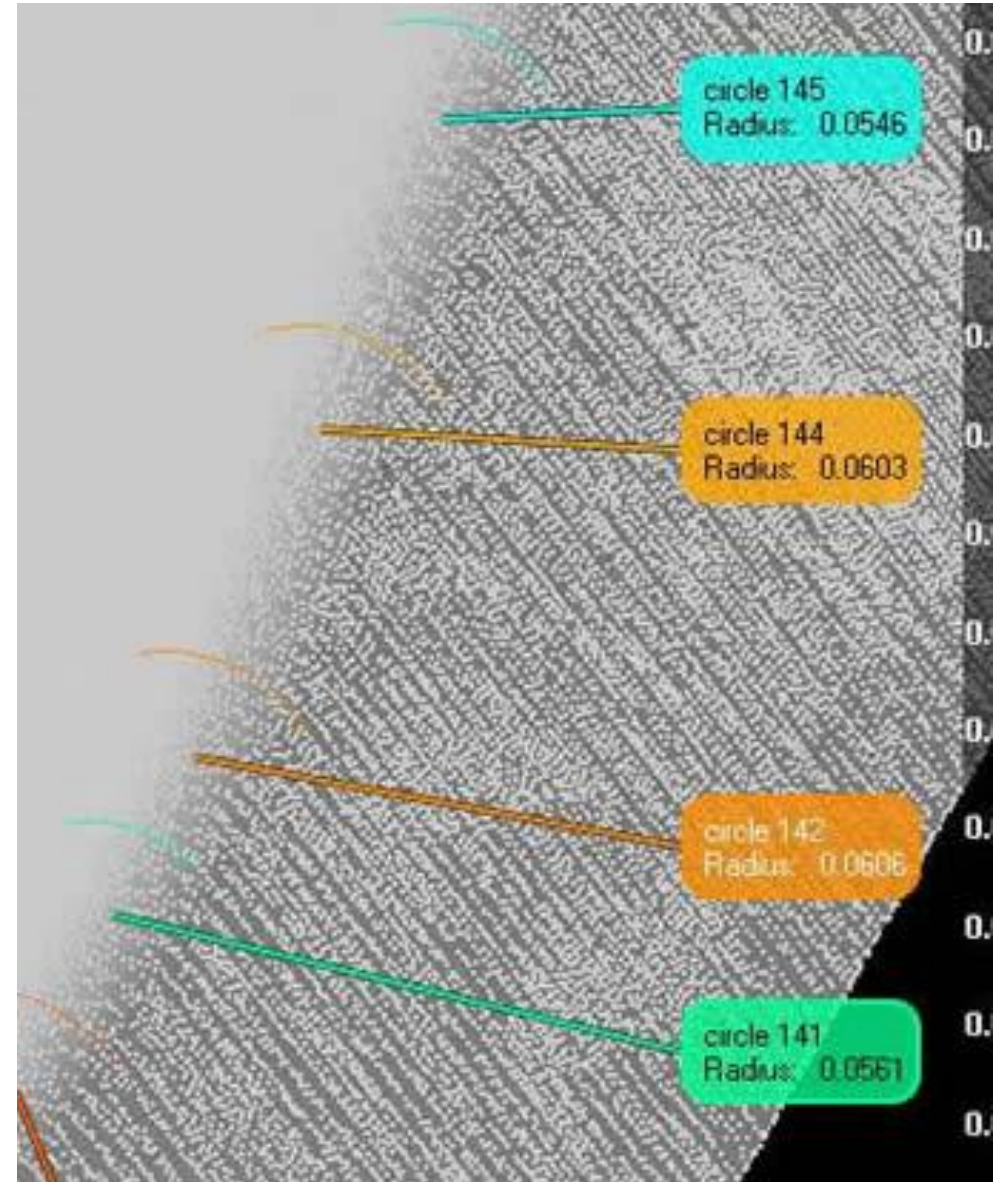
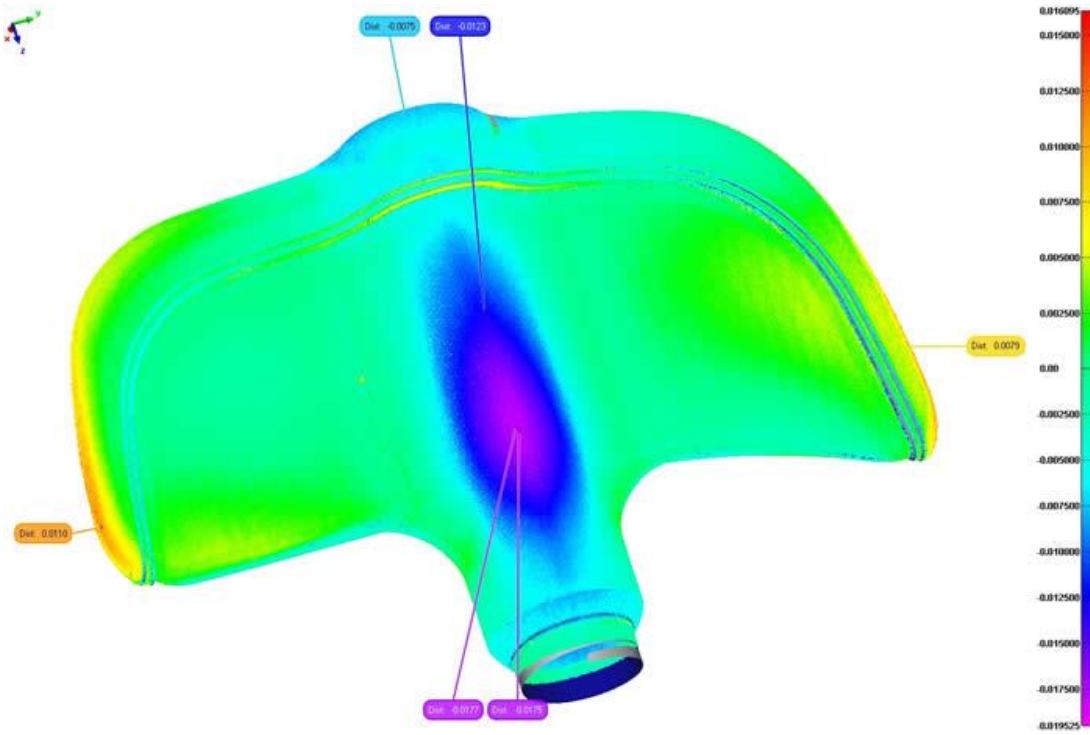


geomagic<sup>®</sup>qualify

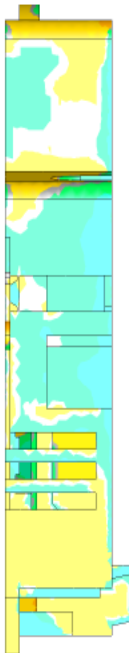
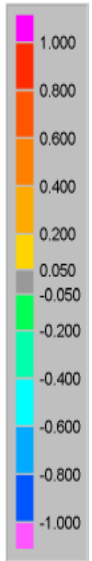
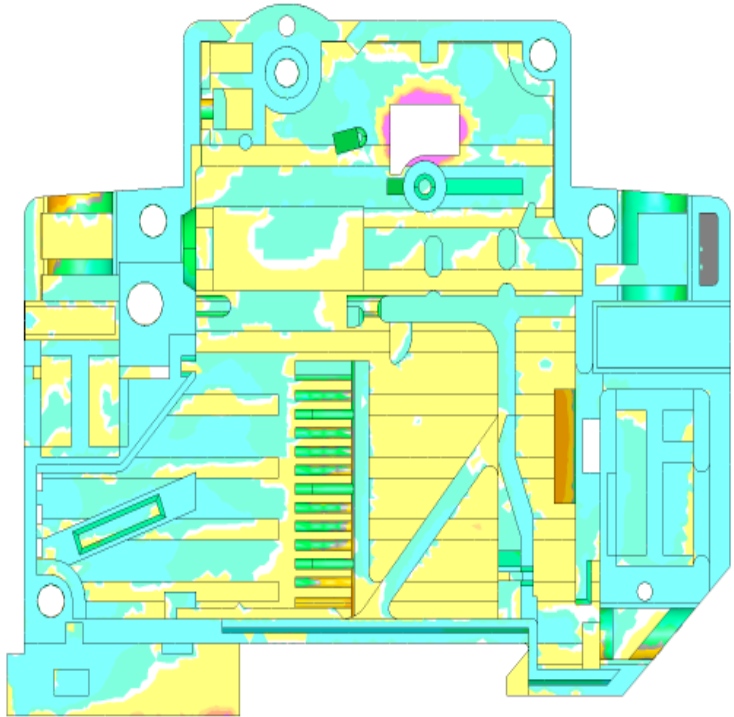
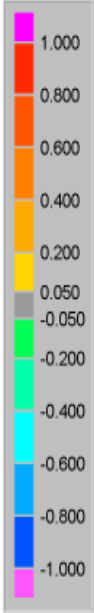
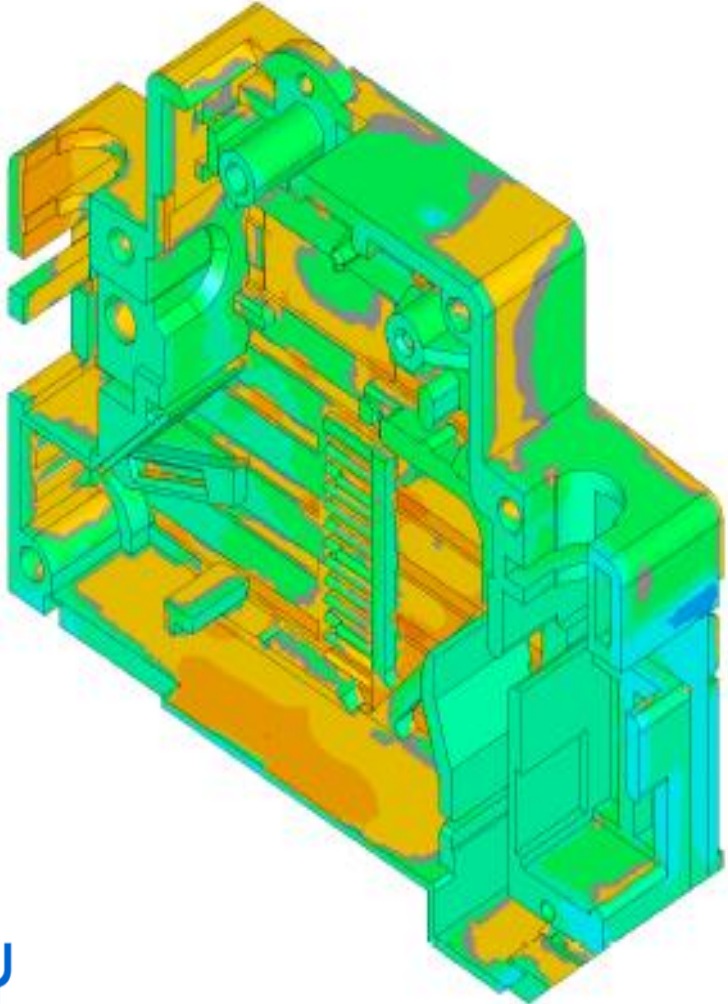
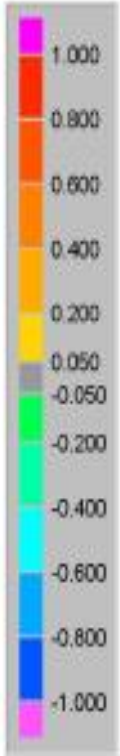


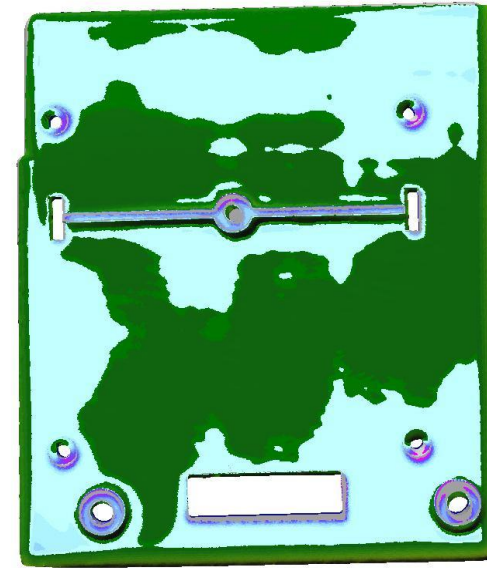
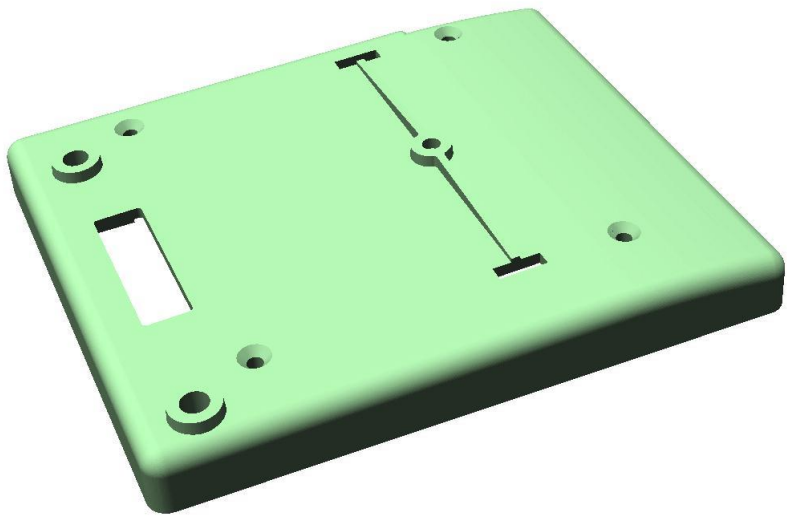
**CAD-INSPEKCIJA  
kod obrade rezanjem**



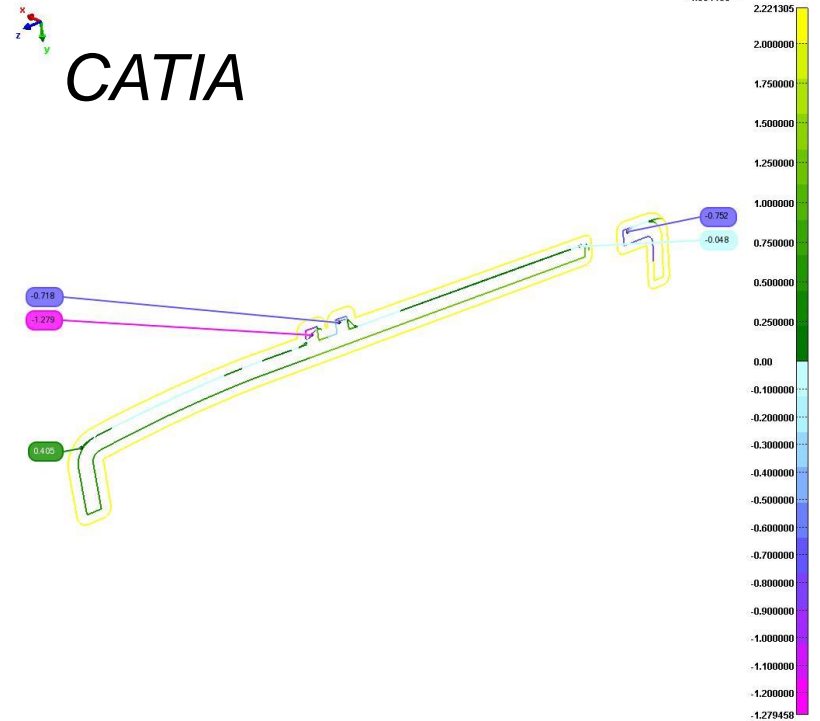


# CAD-INSPEKCIJA dela brizganog od plastike

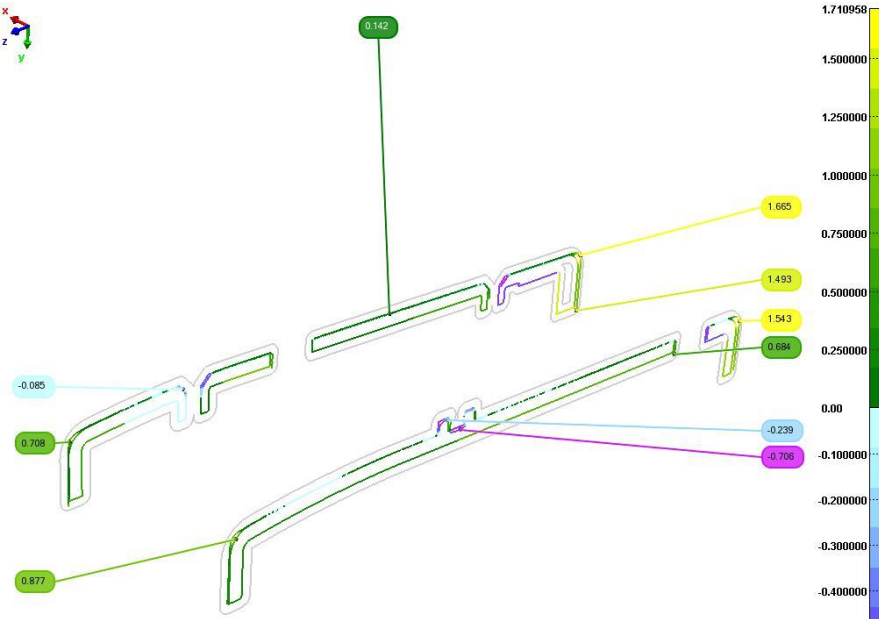
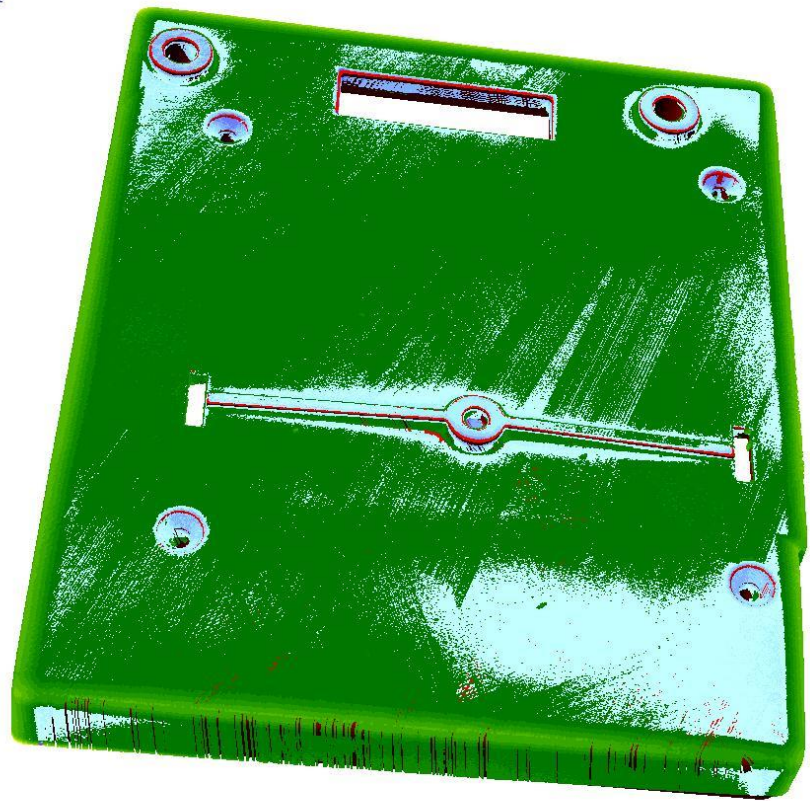




*laser scanner MINOLTA VI – 900*



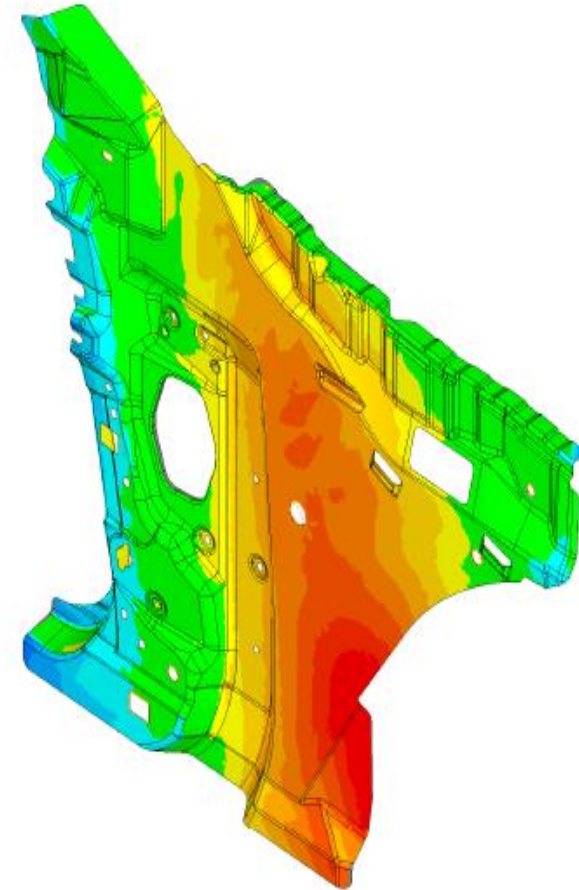
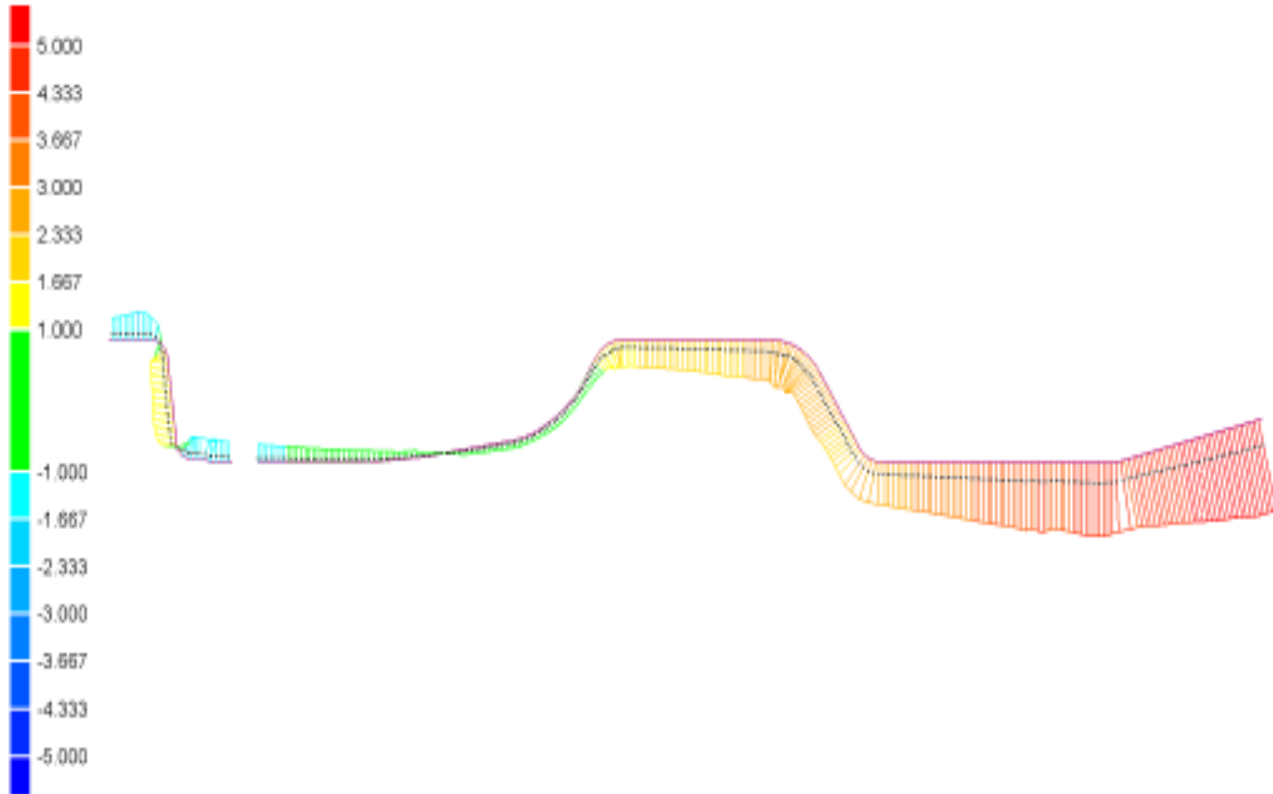
CATIA



# CAD-INSPEKCIJA kod obrade deformisanjem

## Qualify Report

Title: Sheet Metal Example Report  
Author: John Smith  
Client: Ford Motor Co.  
Part: SM-56G  
Test: Sheet Metal - Scan  
4/30/2003, 5:44 pm





# CAD-INSPEKCIJA

*klipa "FIAT ø80"- AD "MOTINS"*



Microsoft Excel - Tacka\_po\_tacka...

File Edit View Insert Format Tools Data  
Window Help Adobe PDF

Arial

A1 = 254.2434

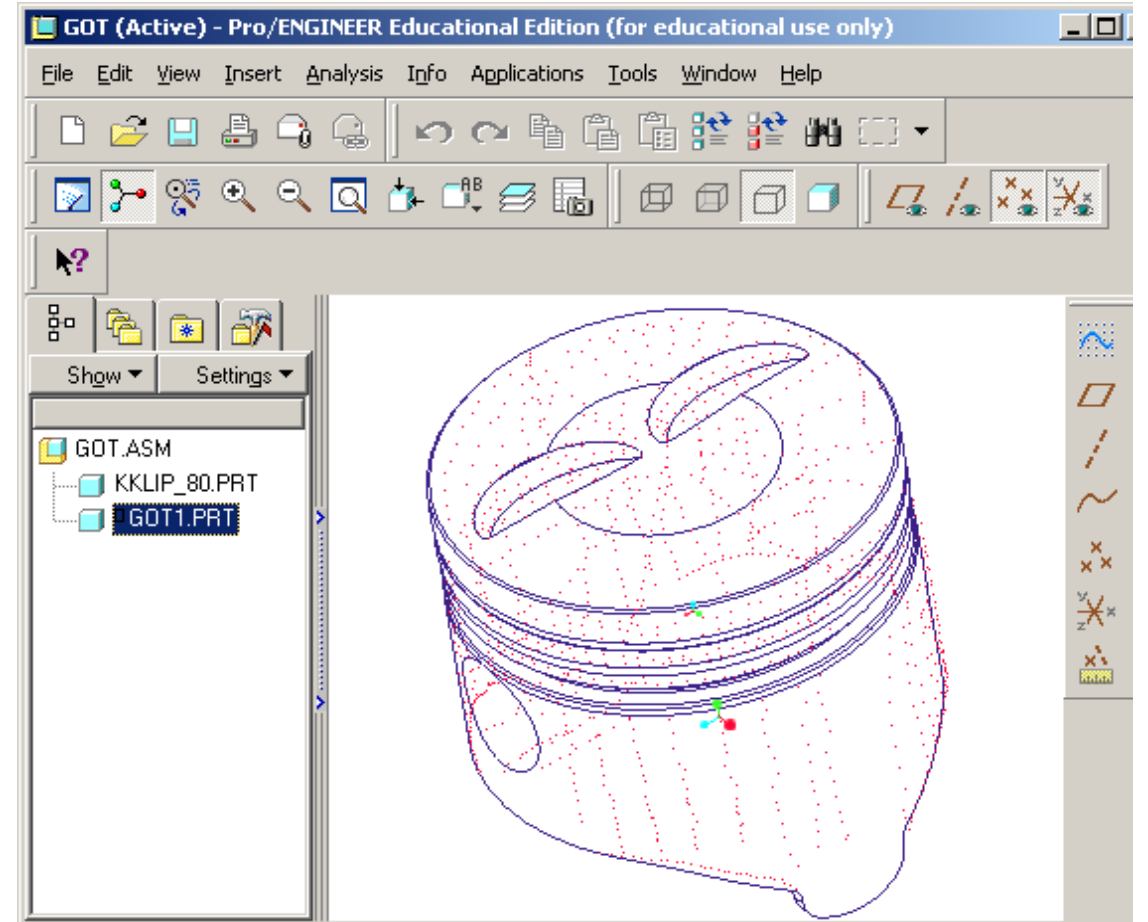
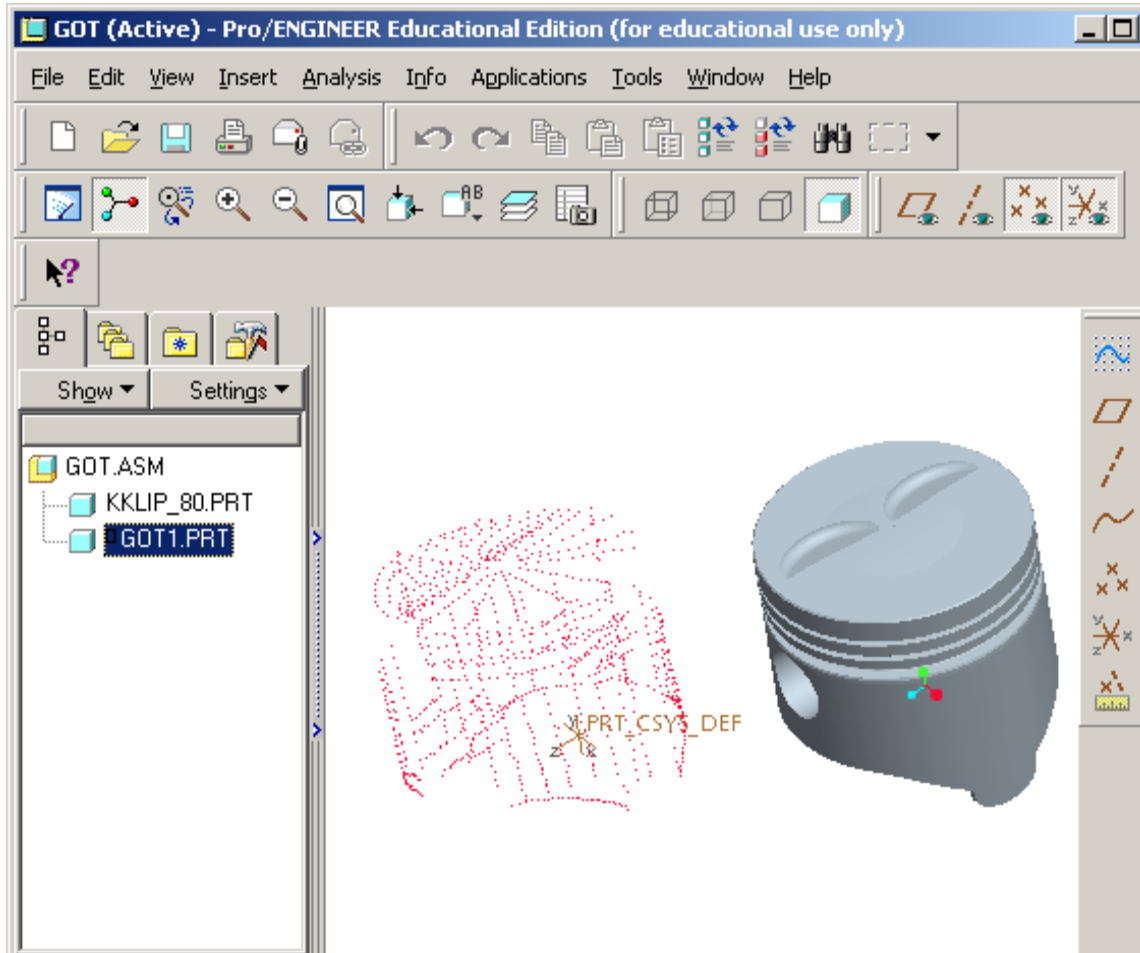
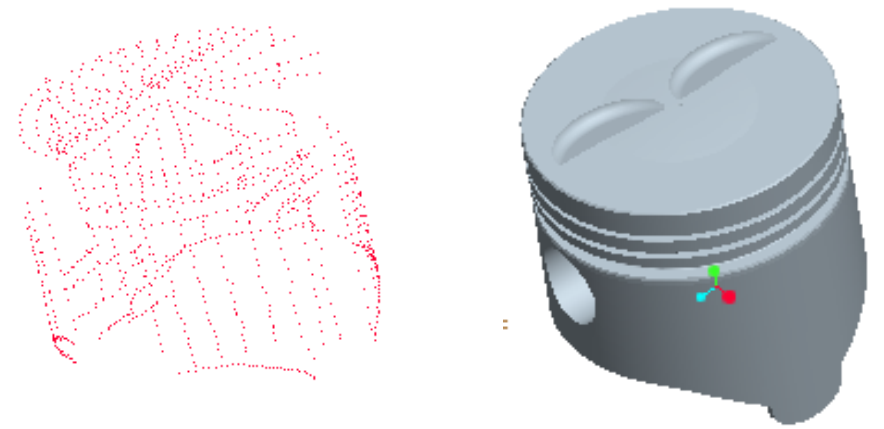
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3	243.0531	1.5321	73.7754	
4	239.0477	1.4409	73.6719	
5	234.9048	1.1252	73.4697	
6	231.6157	0.7576	73.3151	
7	228.0757	0.6151	73.3829	
8	225.3286	0.3371	73.4046	
9	222.3197	-0.0416	73.3383	
10	219.3237	-0.2625	73.3978	
11	216.773	-0.408	73.3606	
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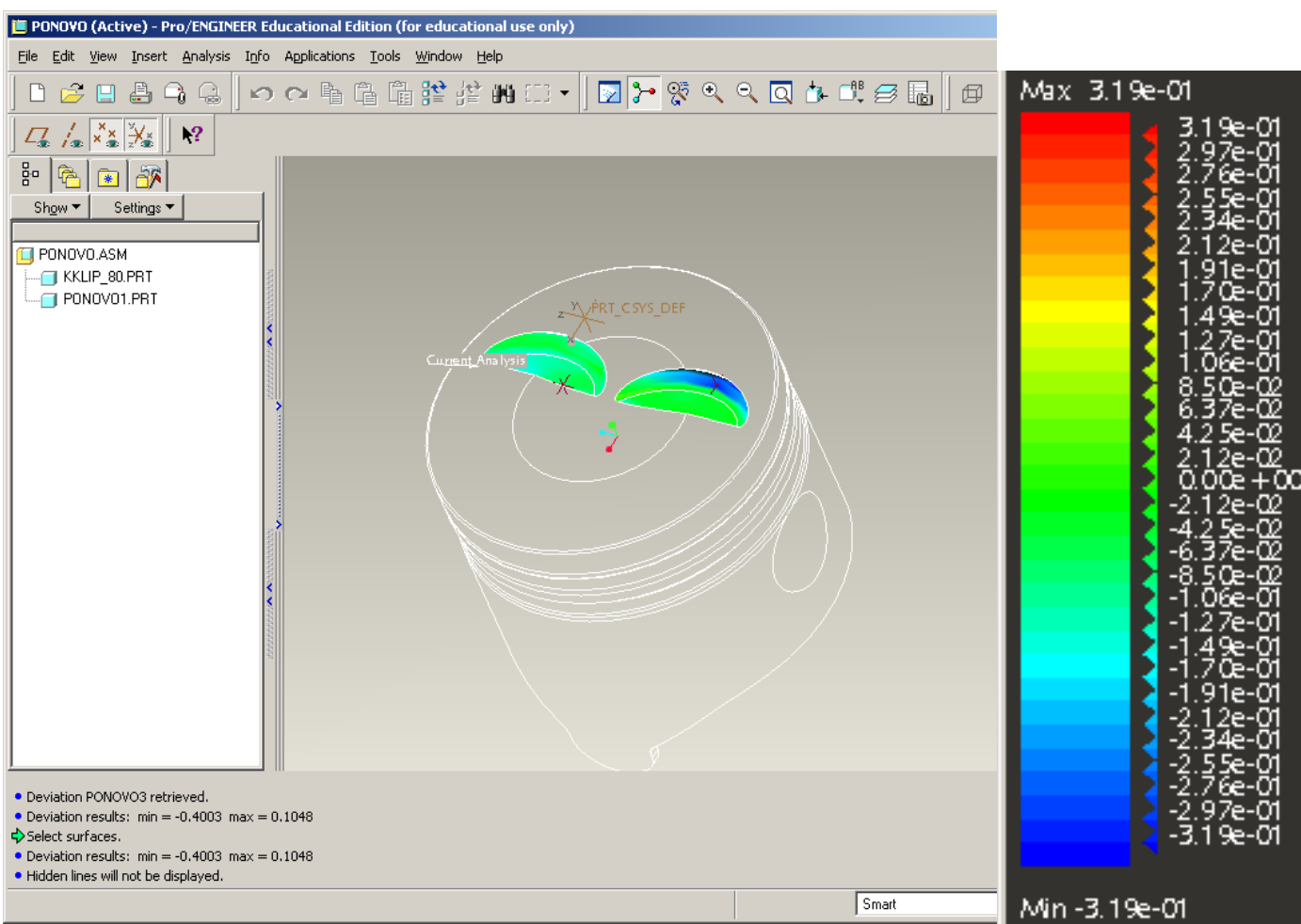
*3D-digitalizacija na 3D-digitajzeru MicroScribe G2X (1093 tačke)*

# CAD-INSPEKCIJA

## klipa "FIAT ø80"- AD "MOTINS"

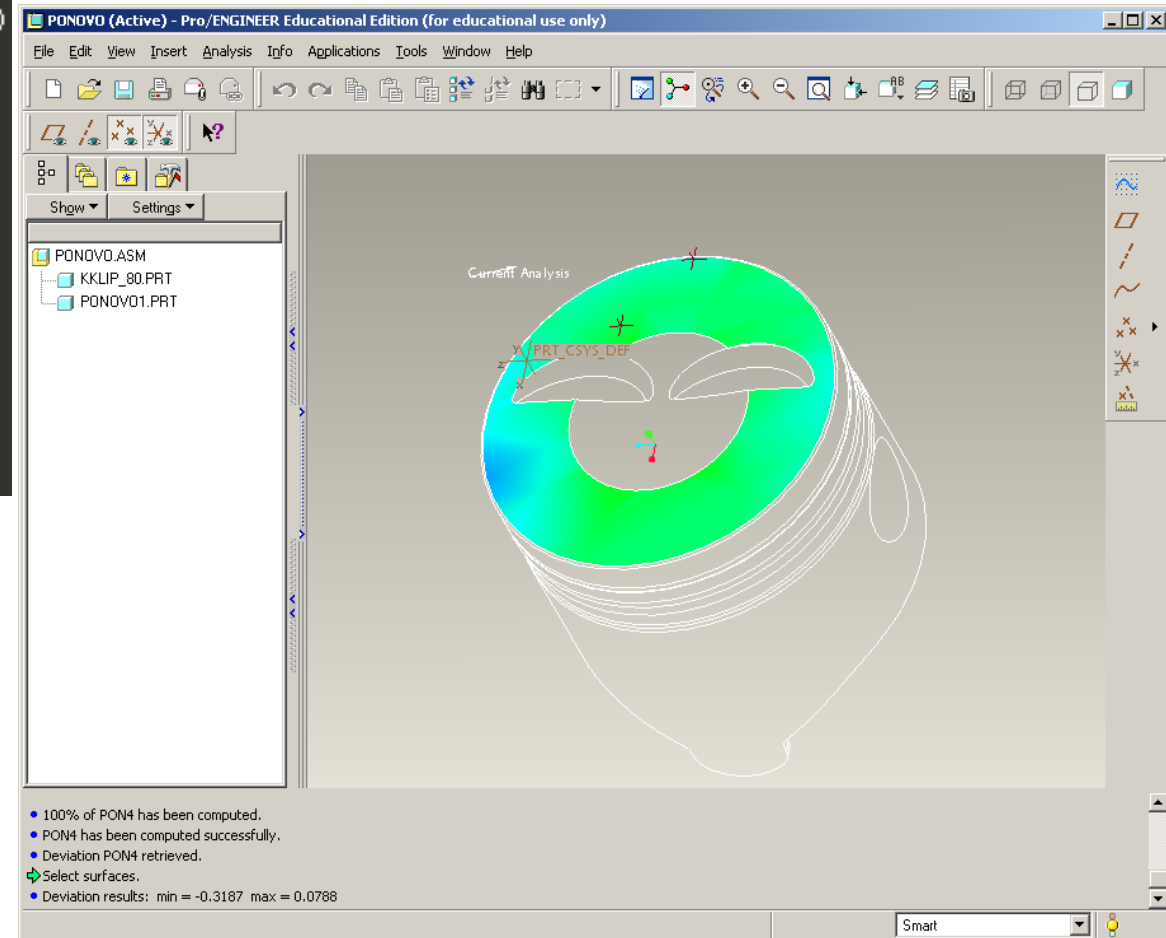
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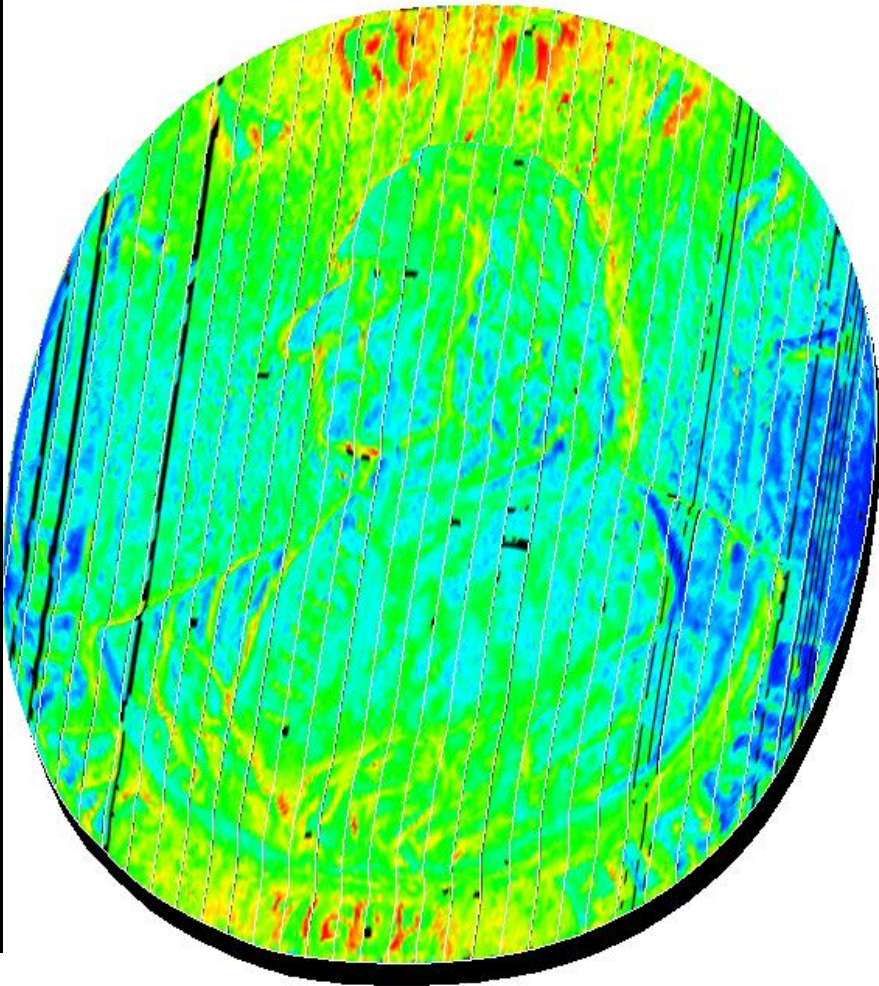
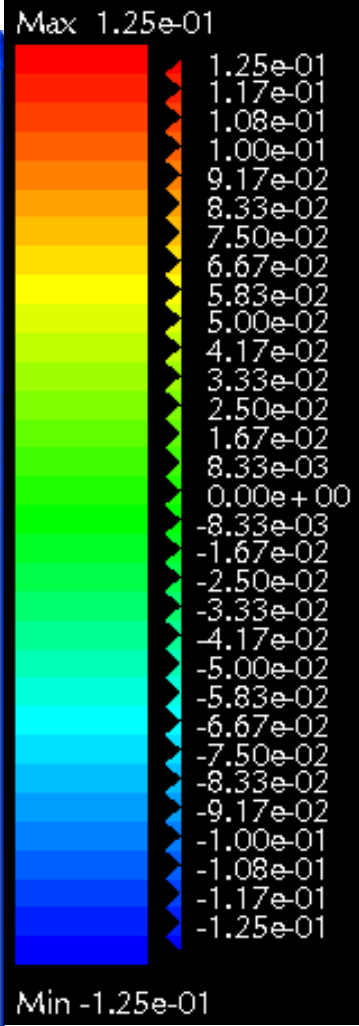
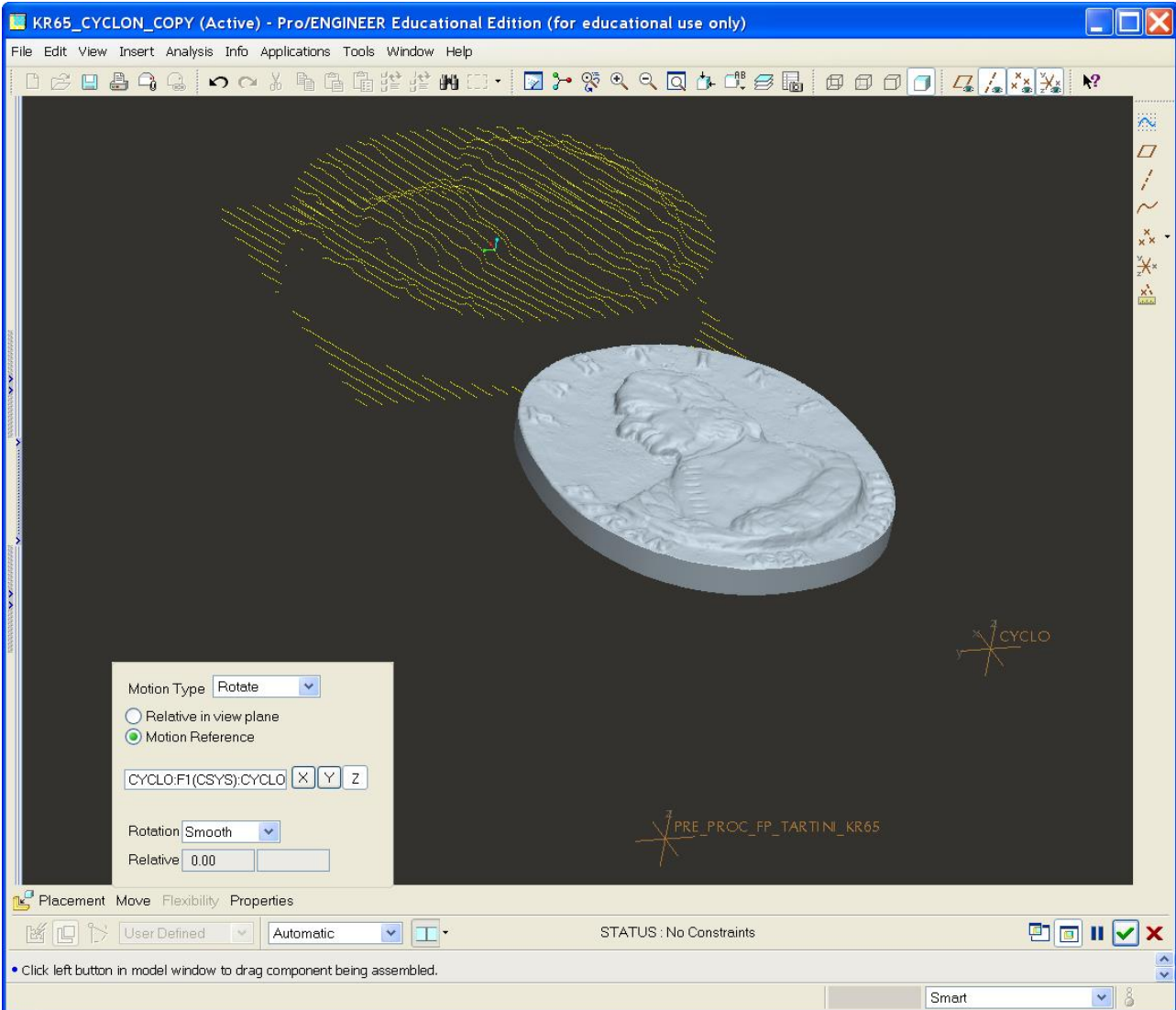


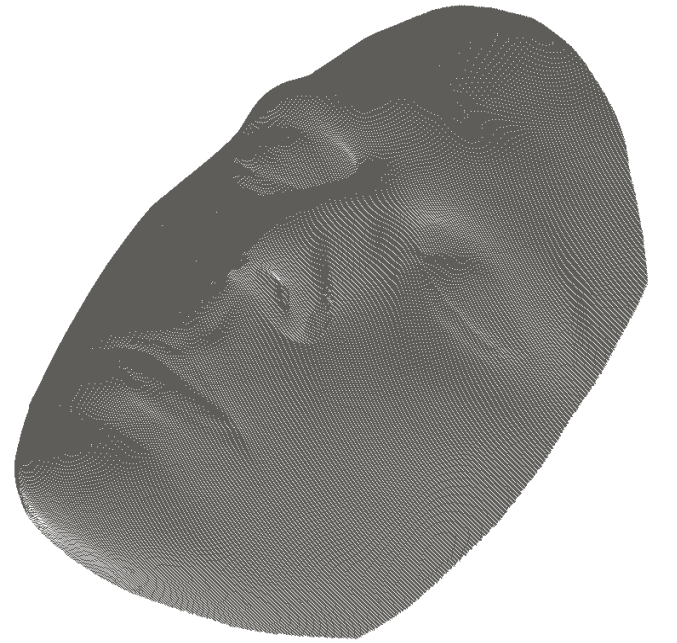
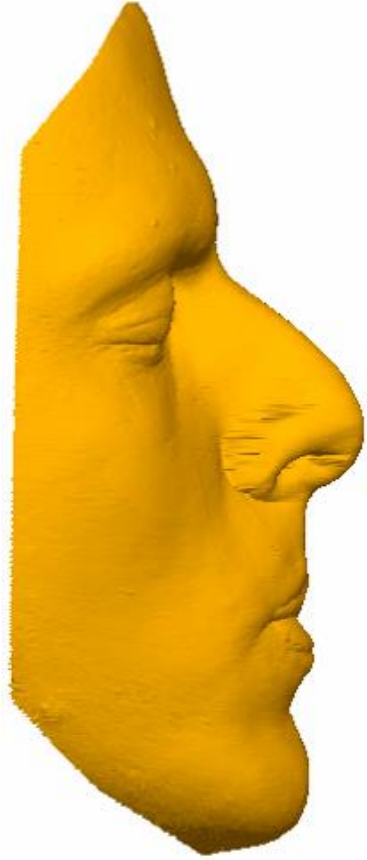


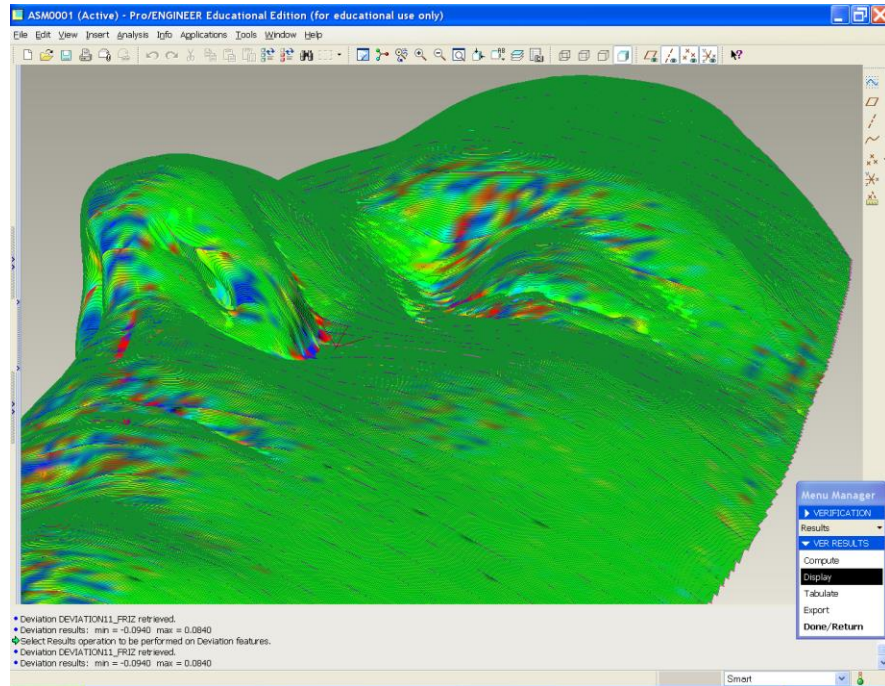
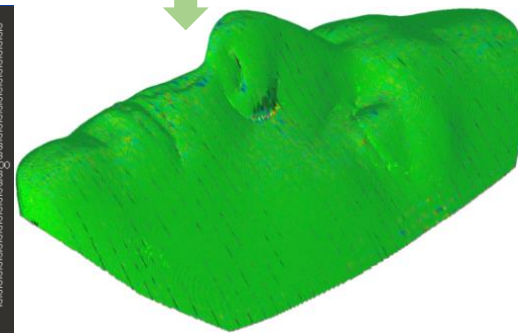
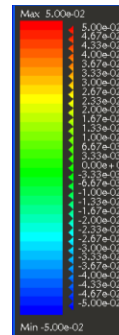
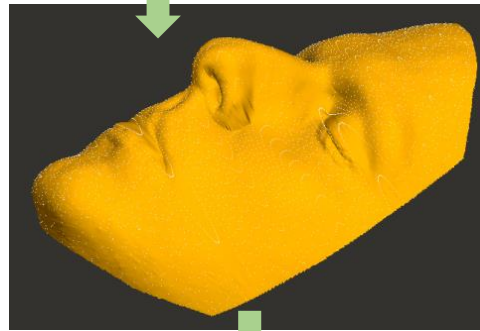
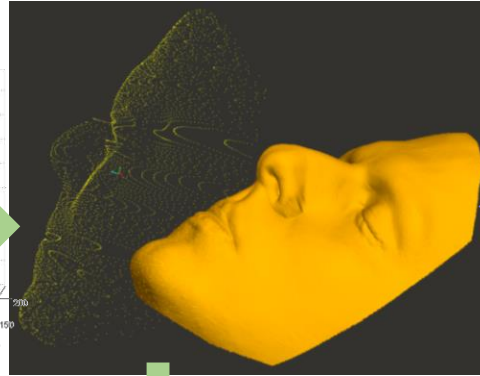
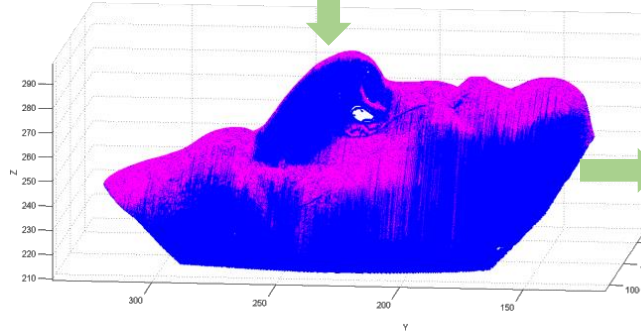
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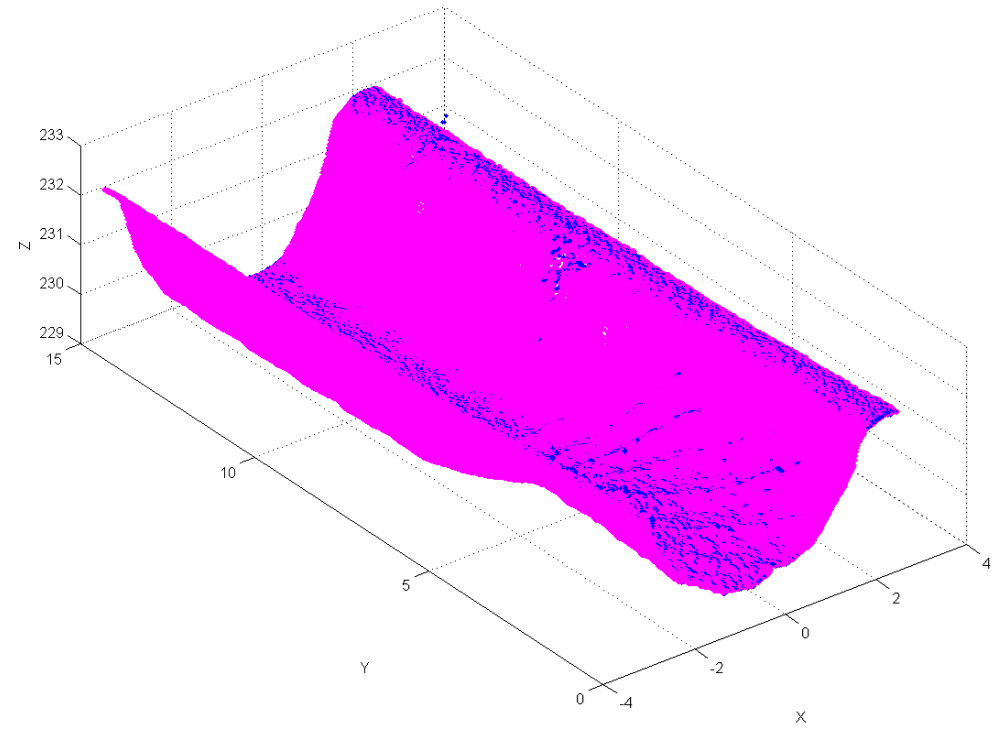
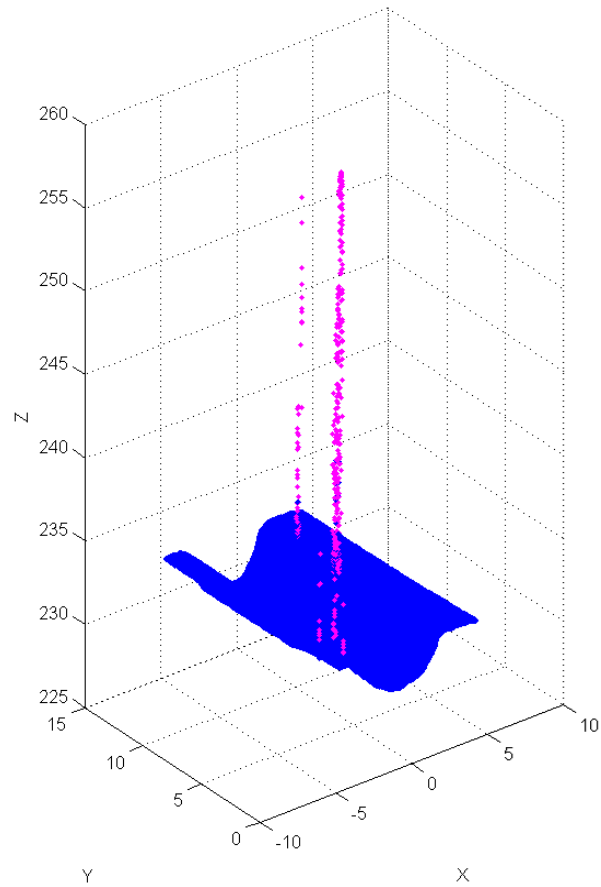
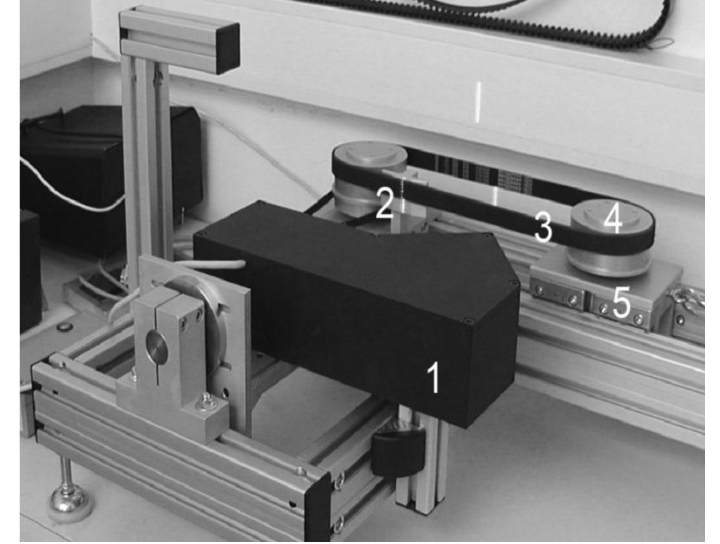
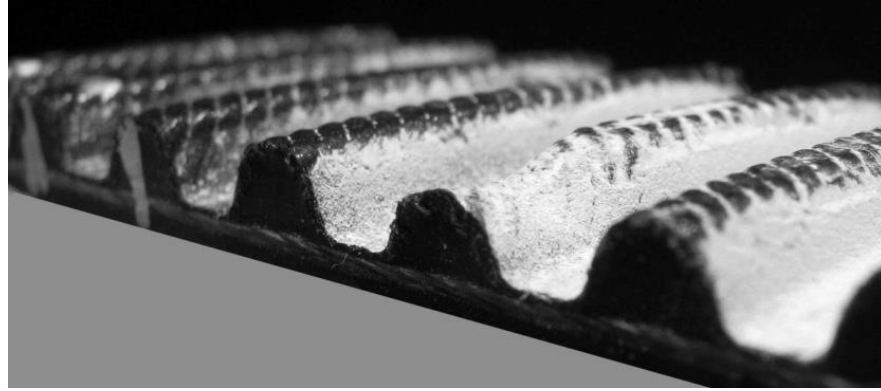
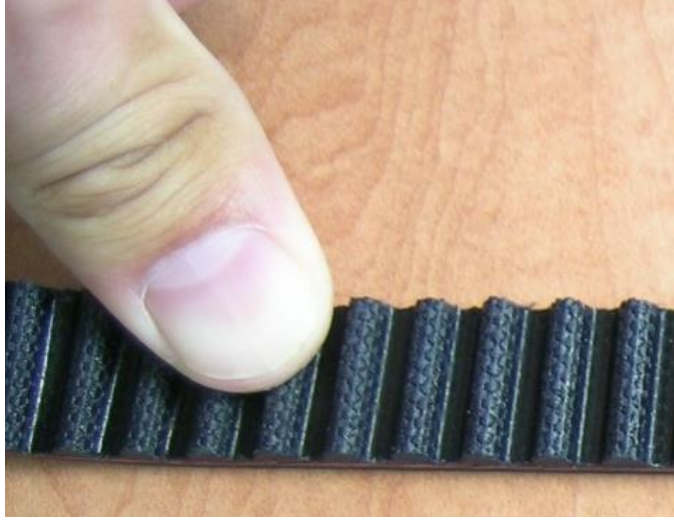
Rezultat odstupanja  
u Pro/VERIFY

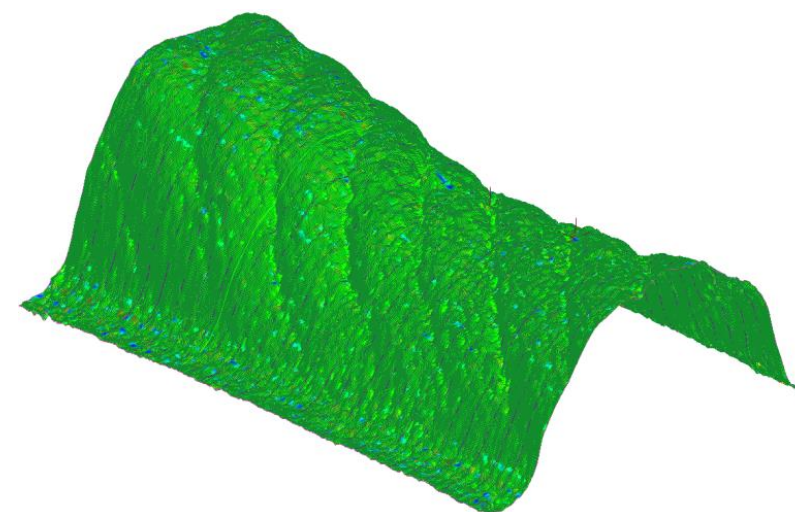
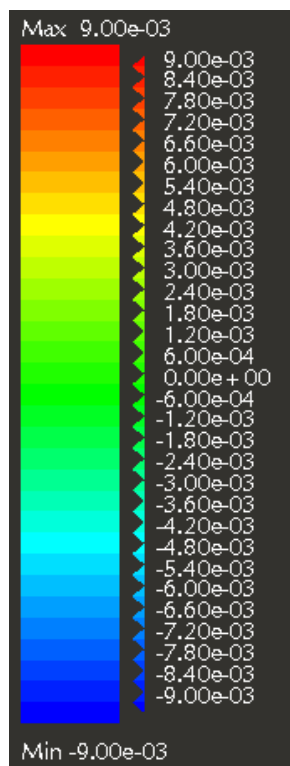
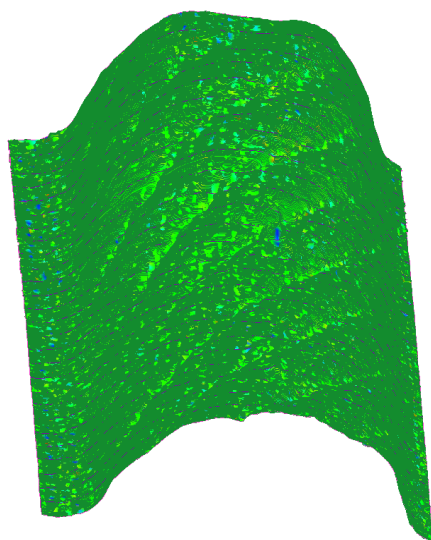
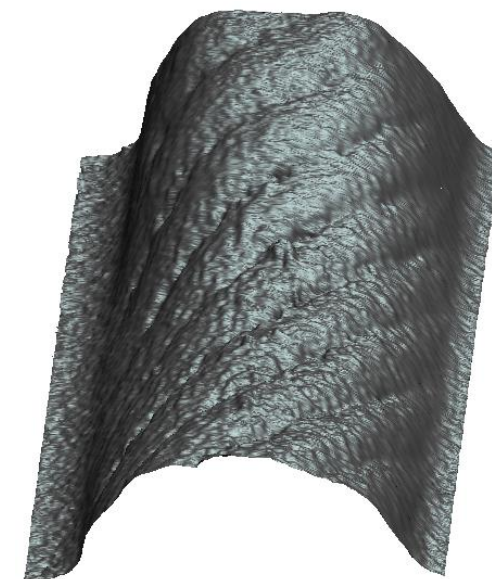
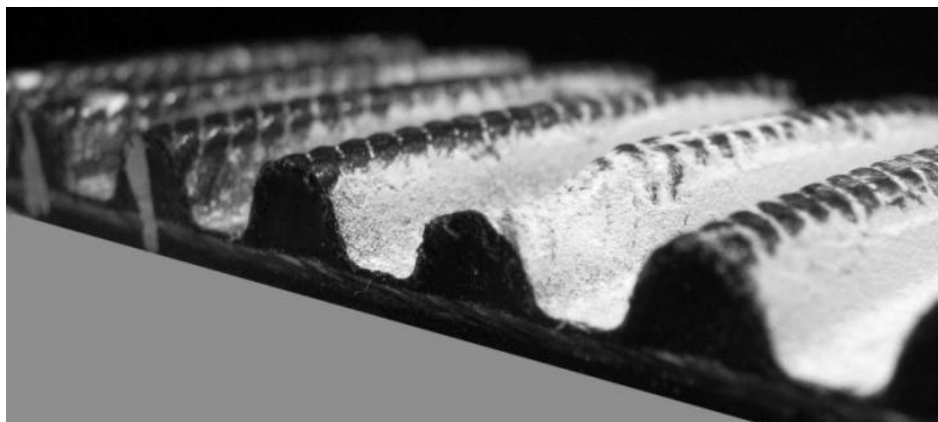
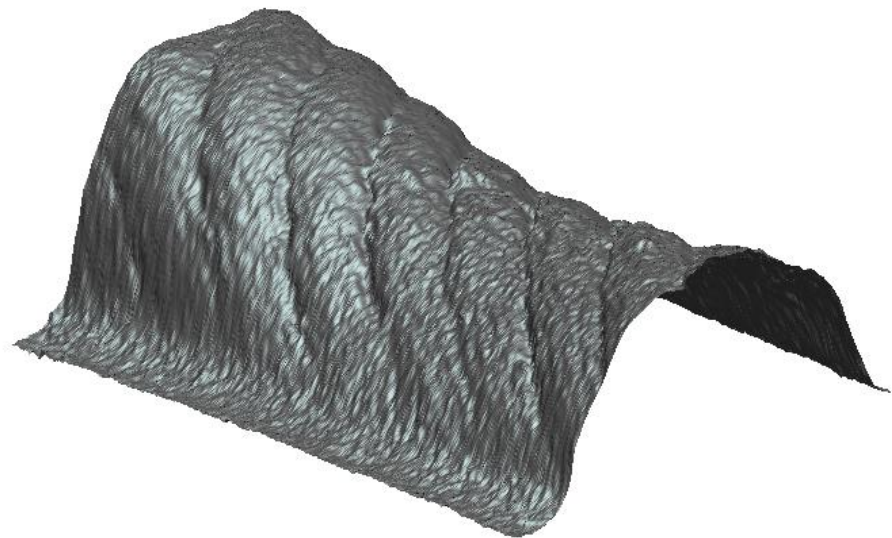




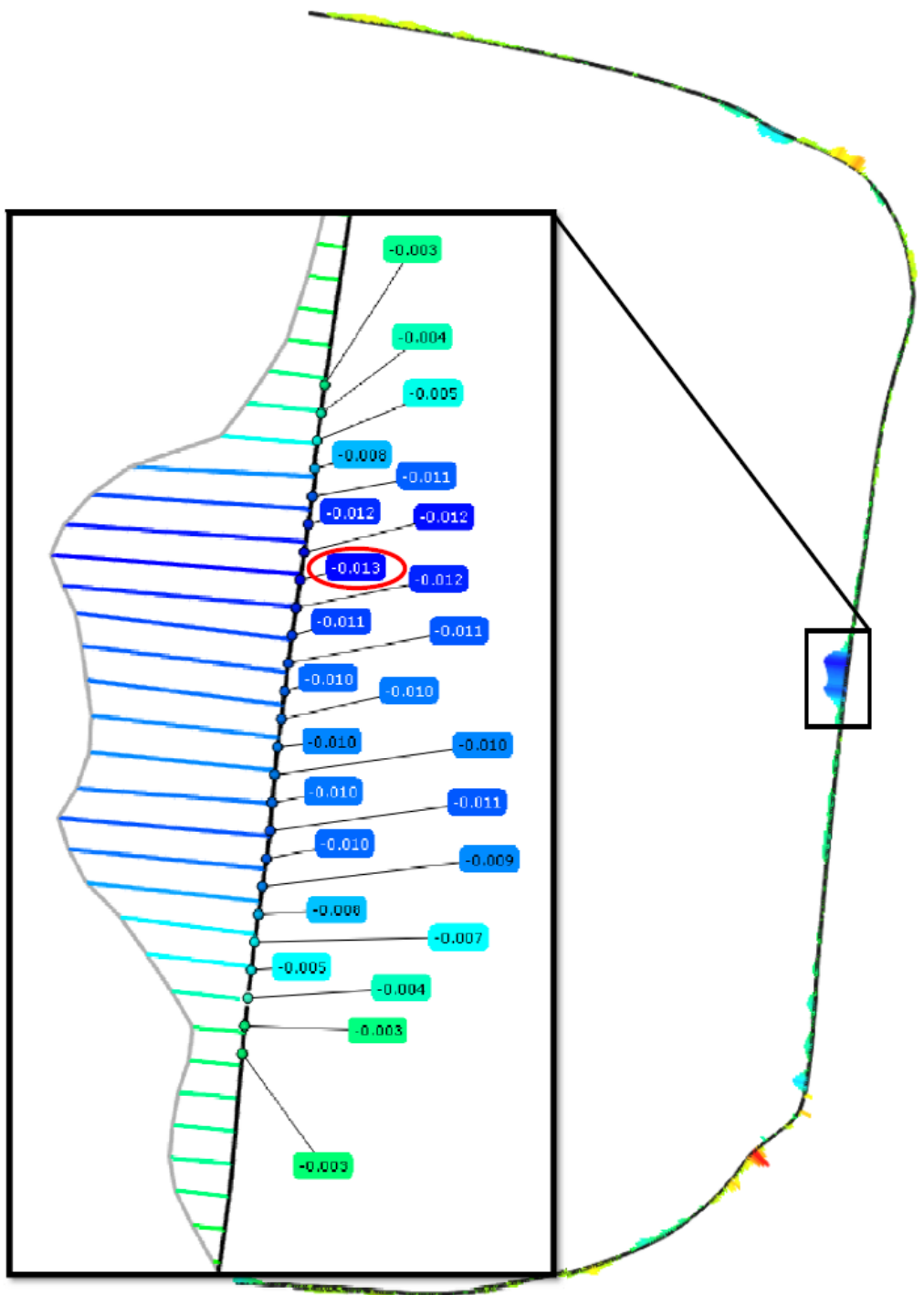
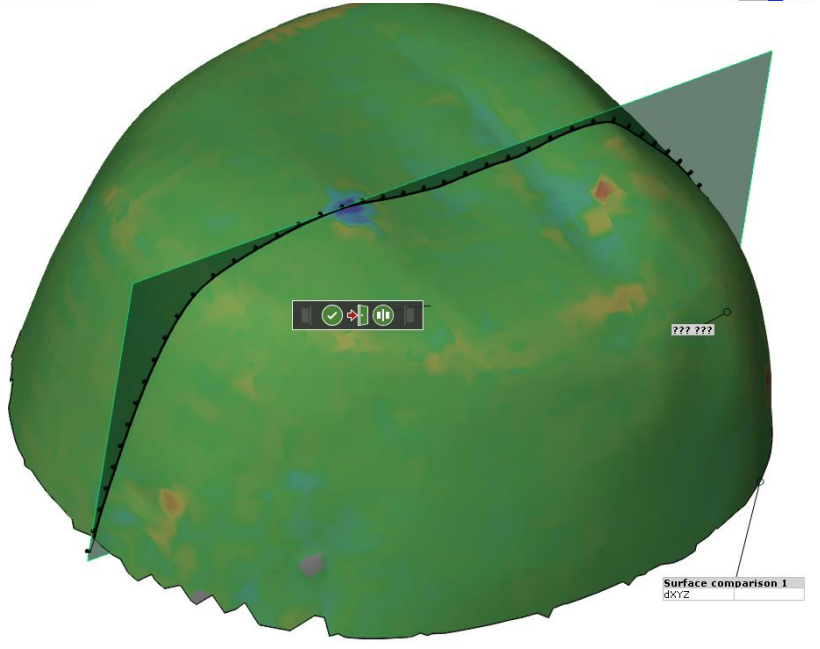
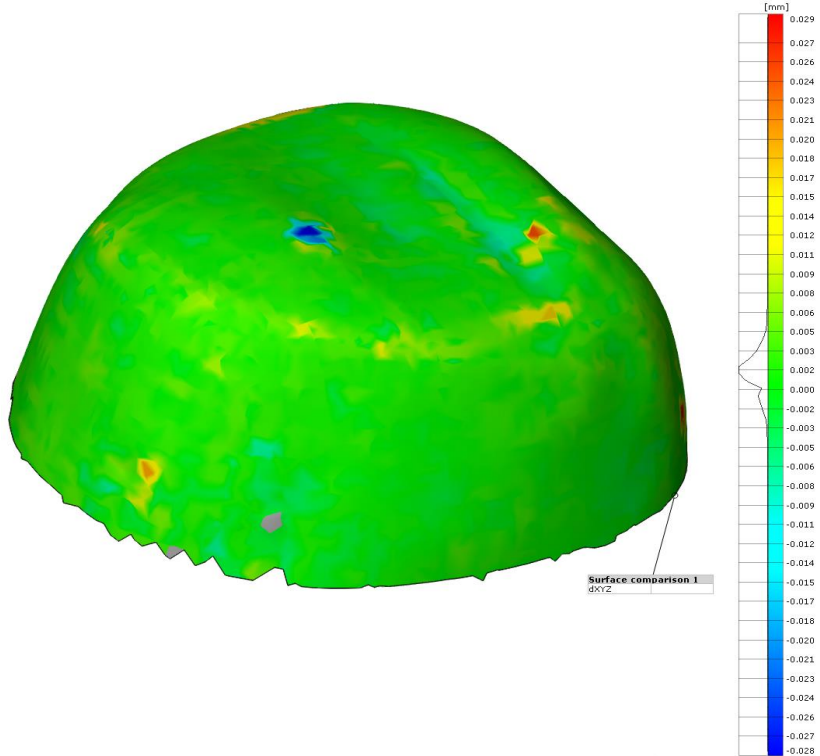


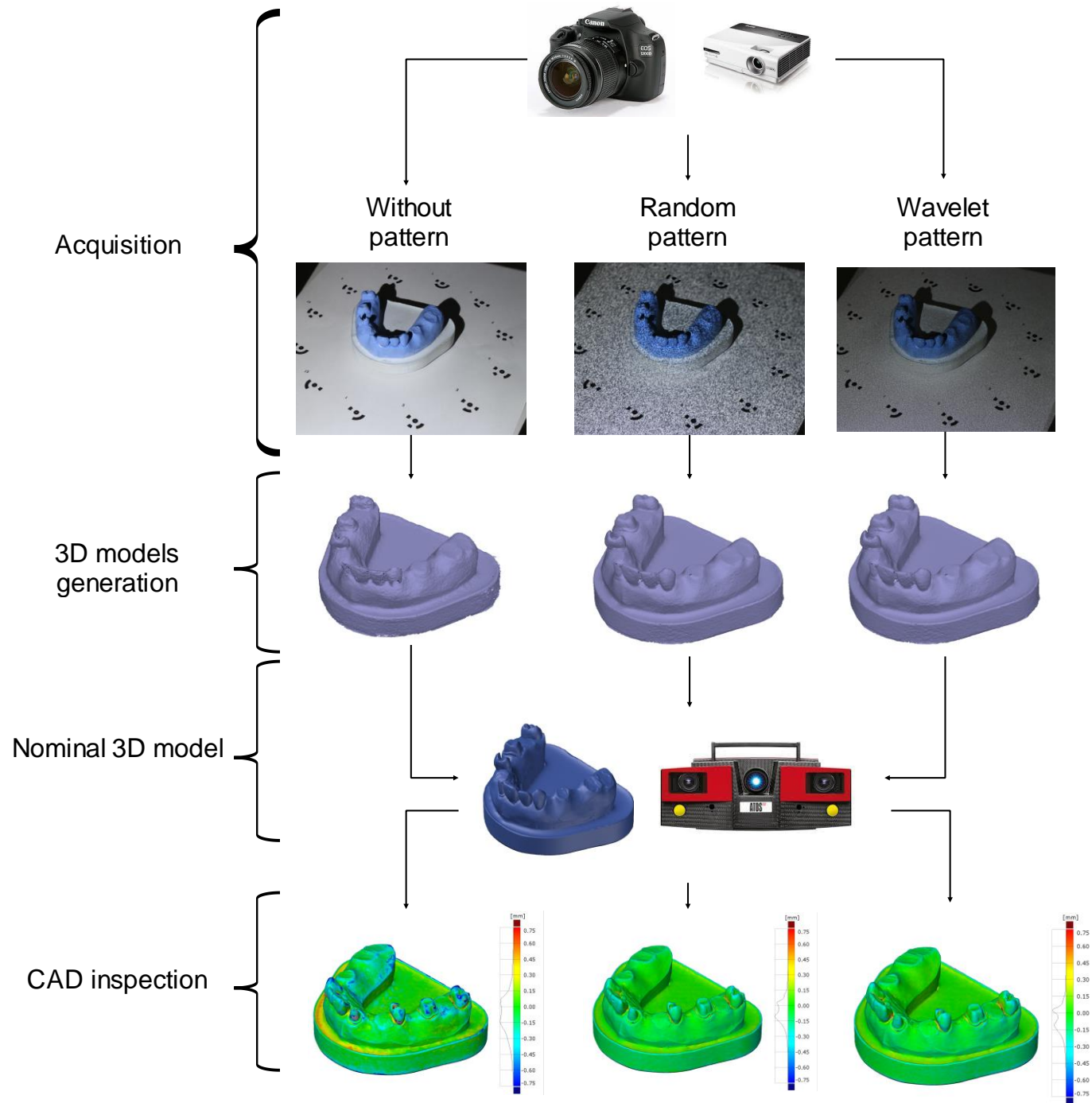












*Pitanja, komentari, diskusija...*