



Univerzitet u Beogradu – Građevinski  
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Studijski program:

**GRAĐEVINARSTVO**

Modul:

**MASTER STUDIJE**

Godina/Semestar:

**1 godina / 1 semestar**

Naziv predmeta (šifra):

**Geoinformacioni sistemi u  
saobraćajnicama (M2S1GI)**

Nastavnik:

**Aleksandar Sekulić**

Naslov predavanja:

**Fotogrametrija**

Datum :

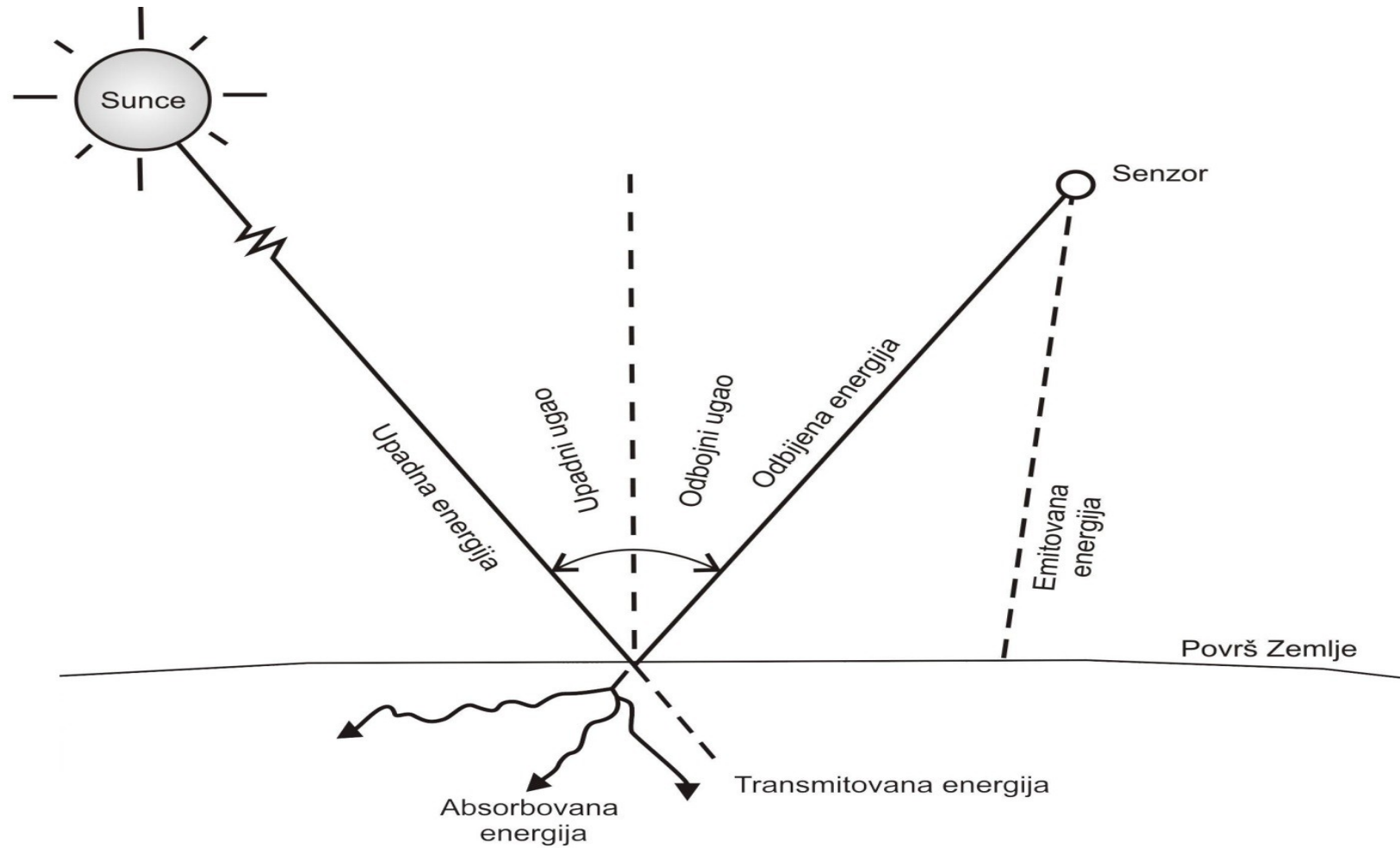
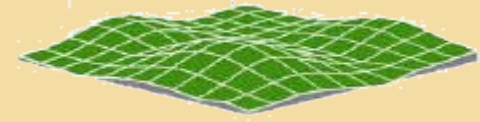
10.11.2021.

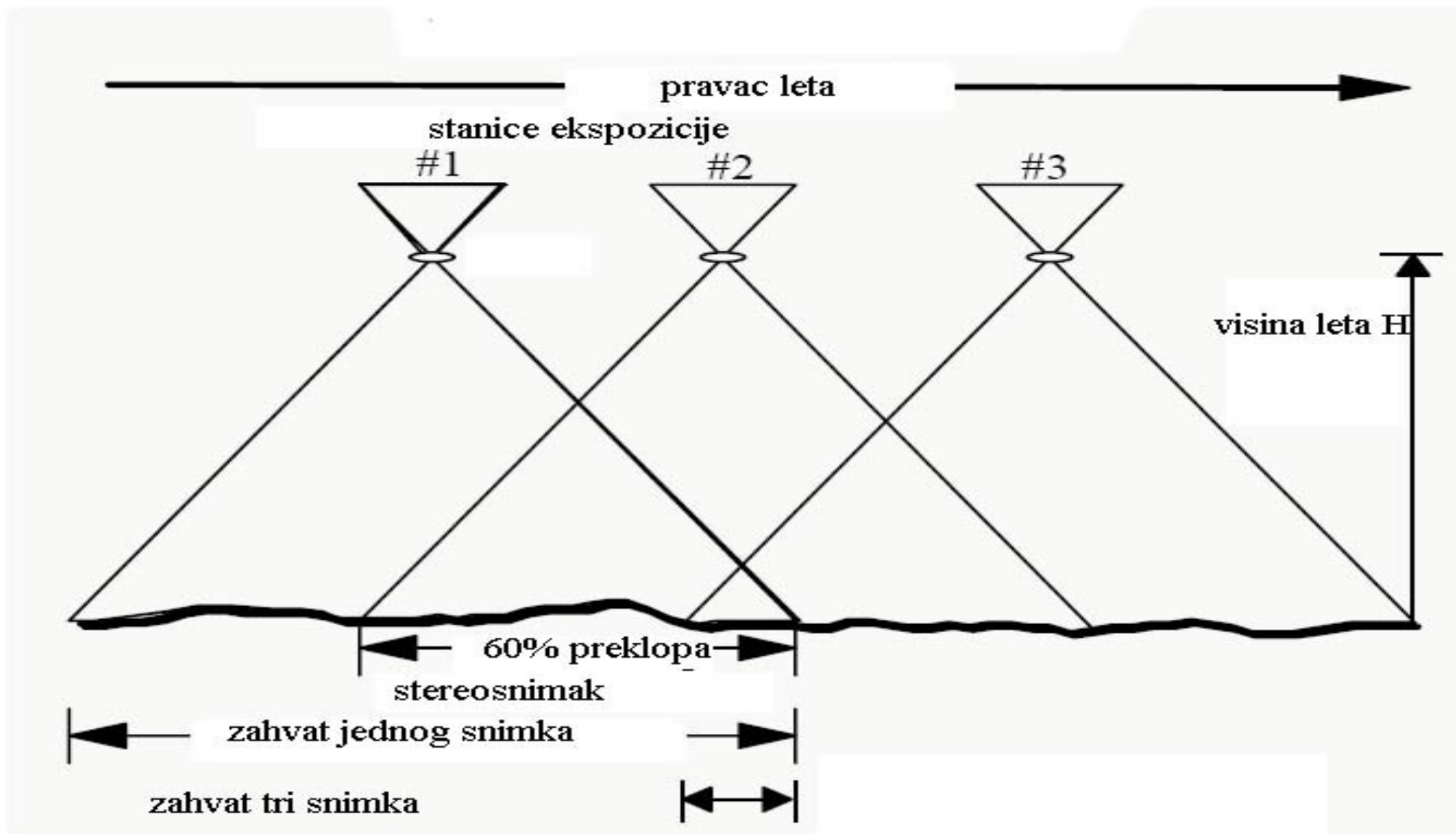
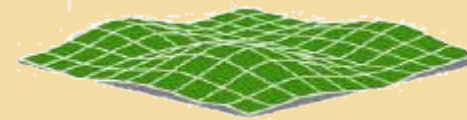
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*Beograd, 2021.*

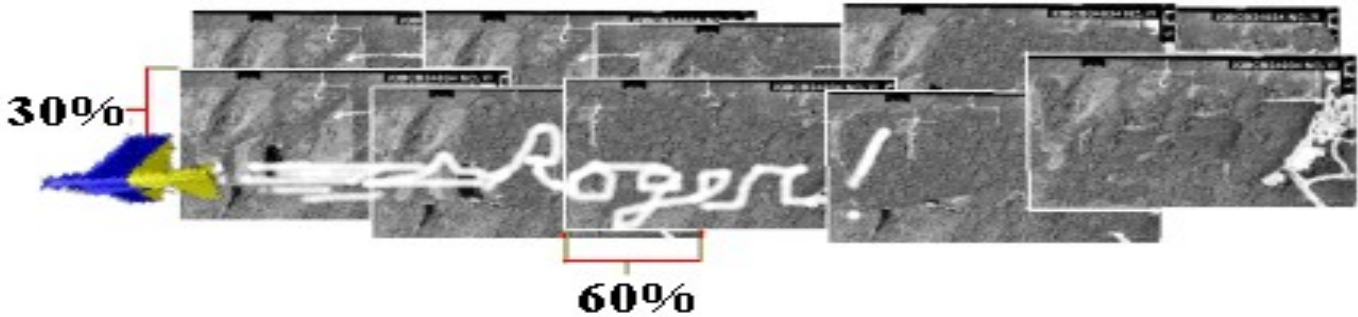
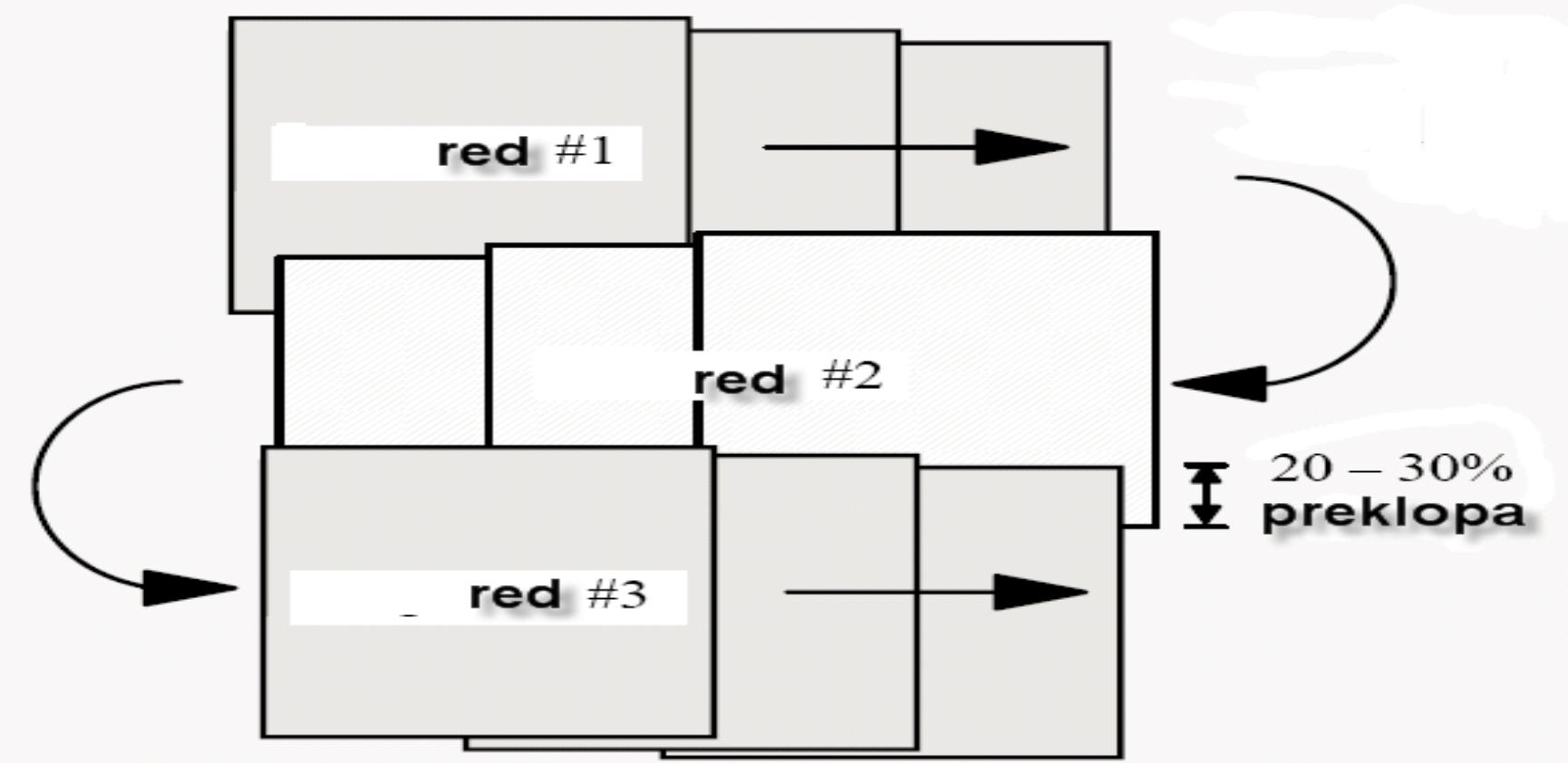
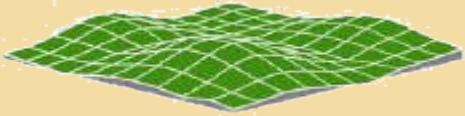
*Sva autorska prava autora prezentacije i/ili video snimaka su zaštićena. Snimak ili prezentacija se mogu koristiti samo za nastavu na daljinu studenta Građevinskog fakulteta Univerziteta u Beogradu u školskoj 2021/2022. i ne mogu se koristiti za druge svrhe bez pismene saglasnosti autora materijala.*

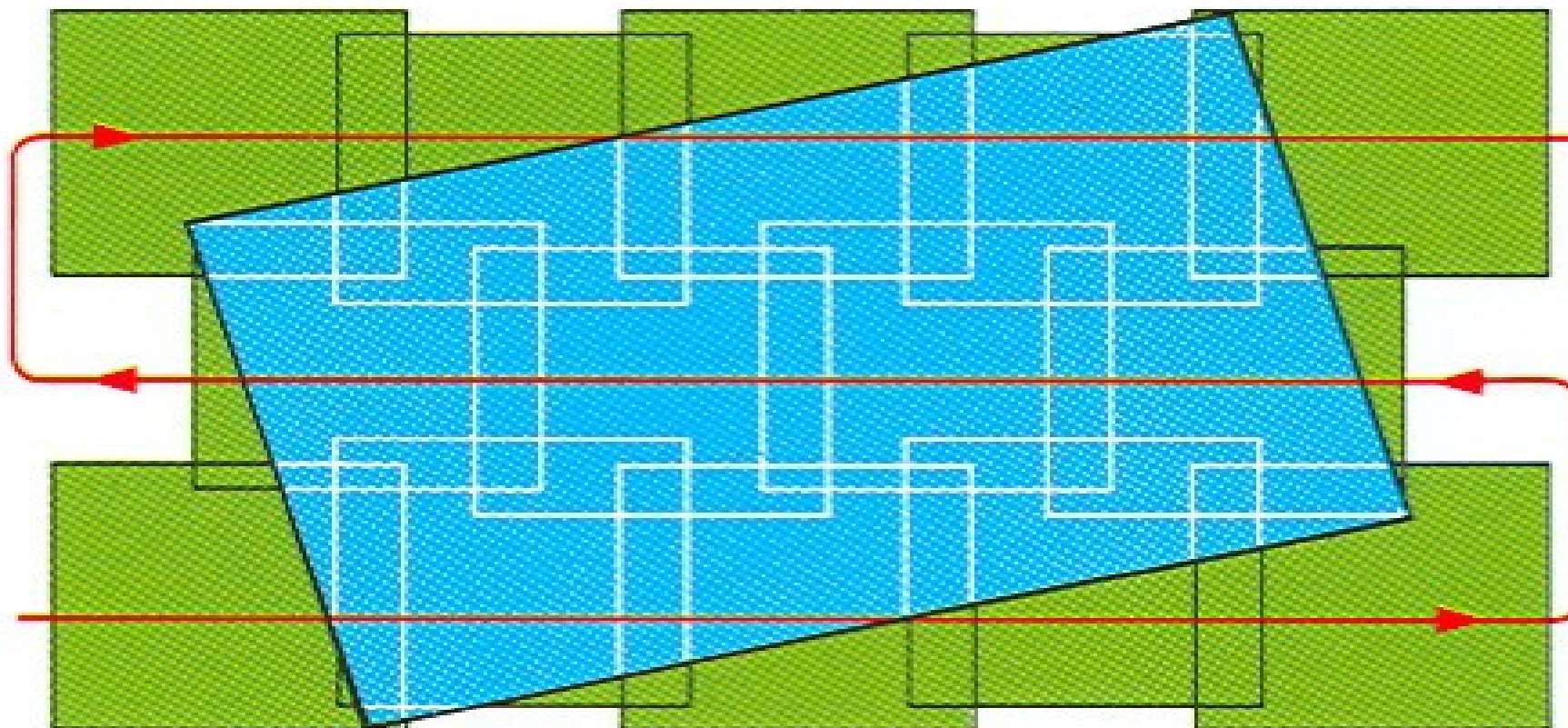
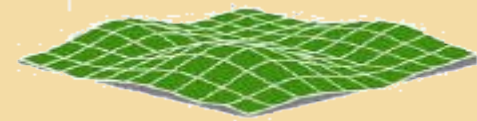
# Fotogrametrija



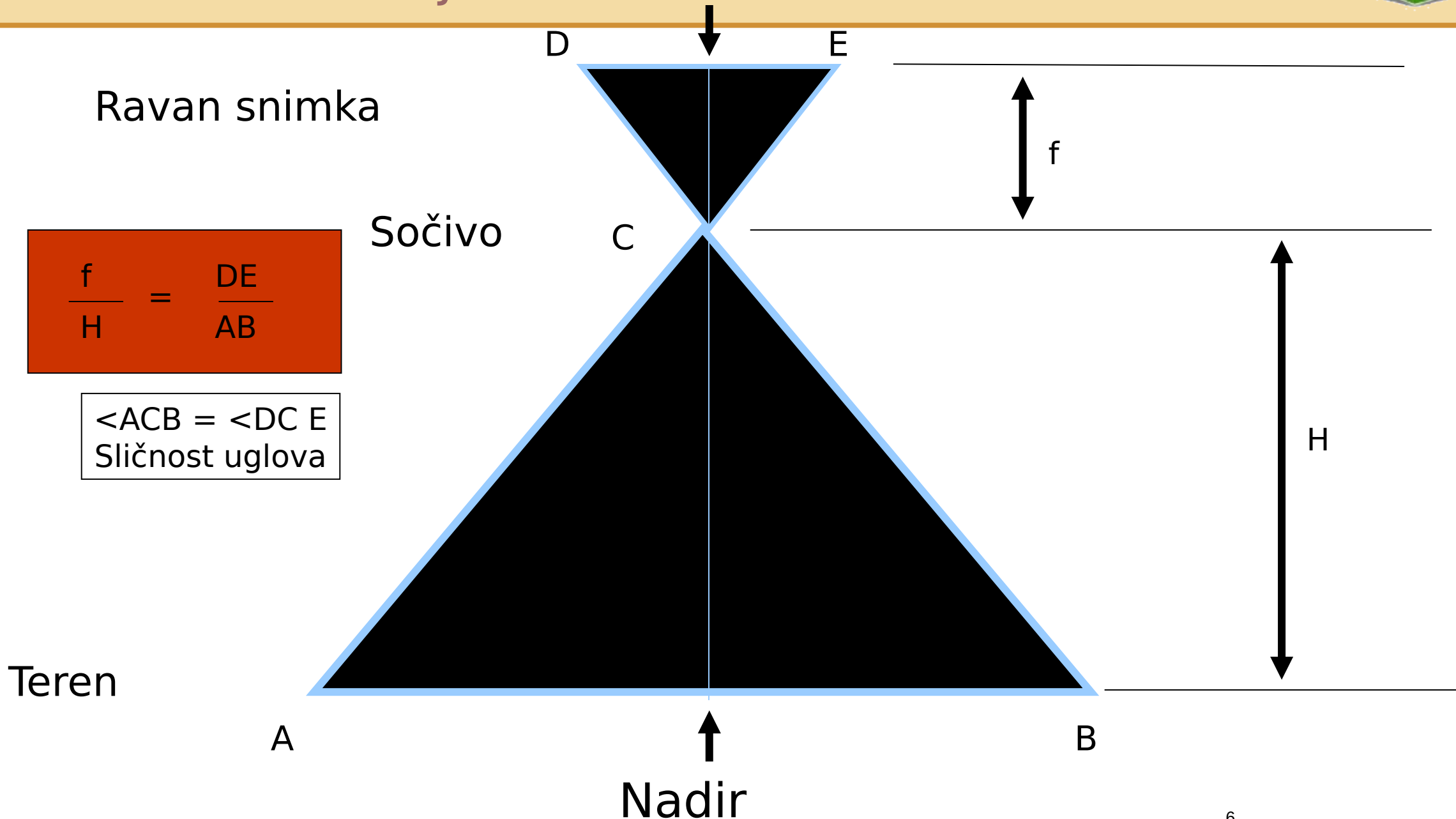
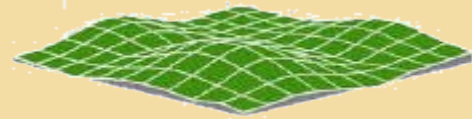


# Aerosnimanje





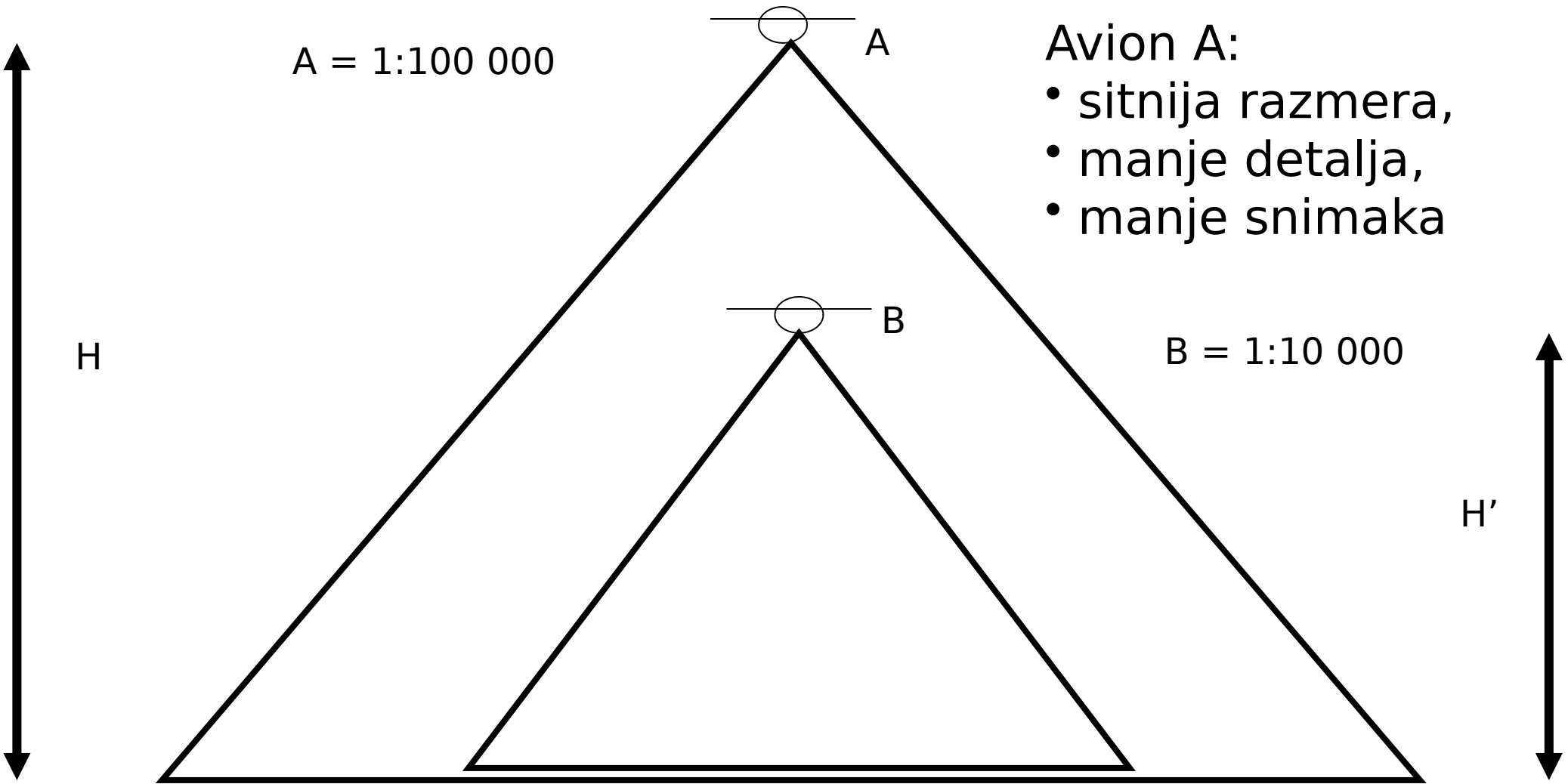
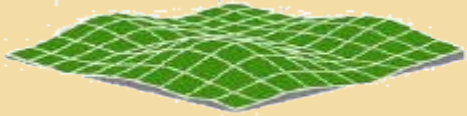
# Razmera snimanja



$$\frac{f}{H} = \frac{DE}{AB}$$

$\angle ACB = \angle DCE$   
Sličnost uglova

# Razmera snimanja



A = 1:100 000

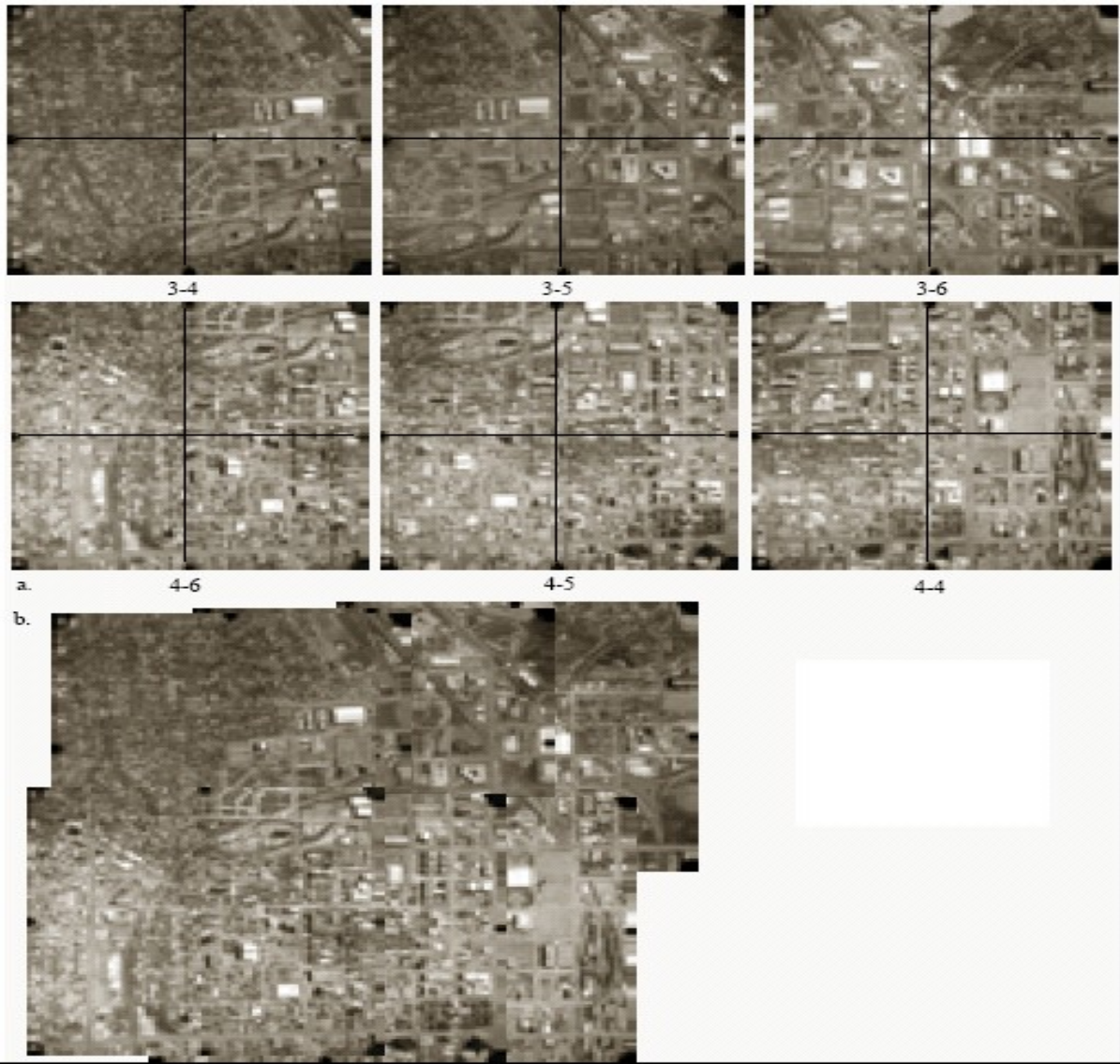
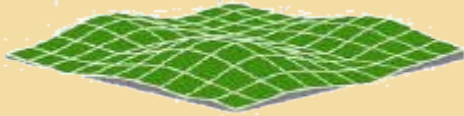
- Avion A:
- sitnija razmera,
  - manje detalja,
  - manje snimaka

B = 1:10 000

H

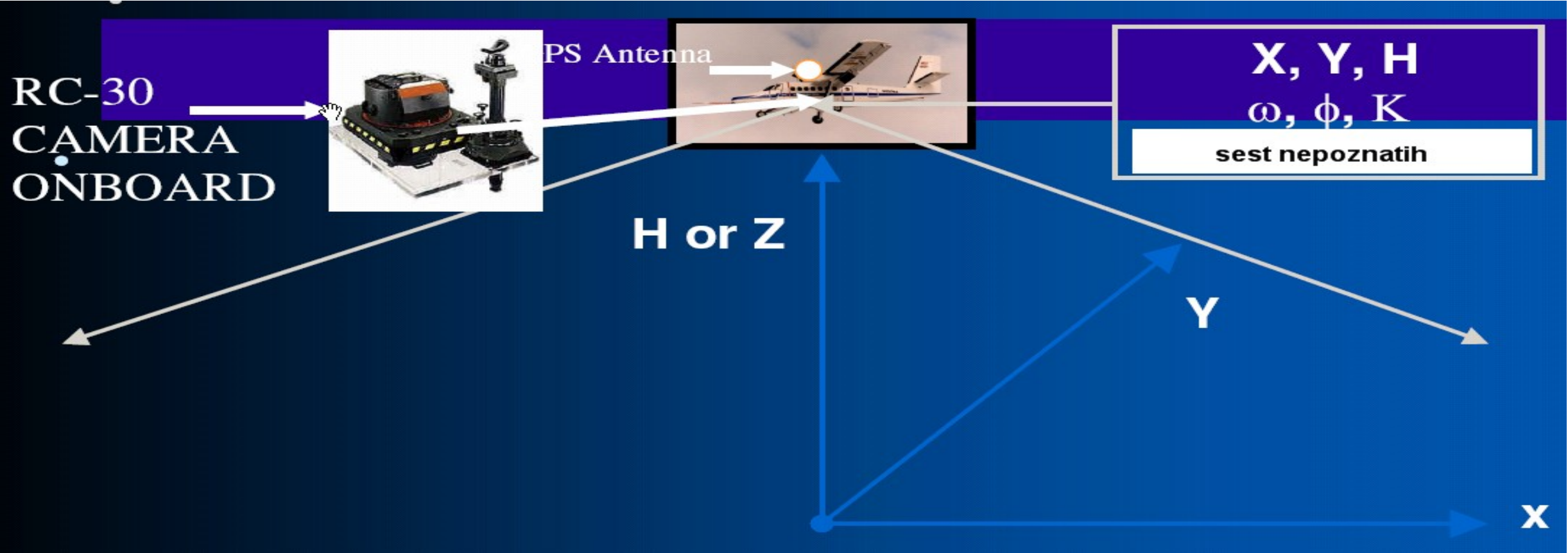
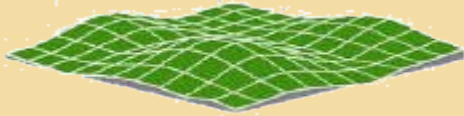
H'

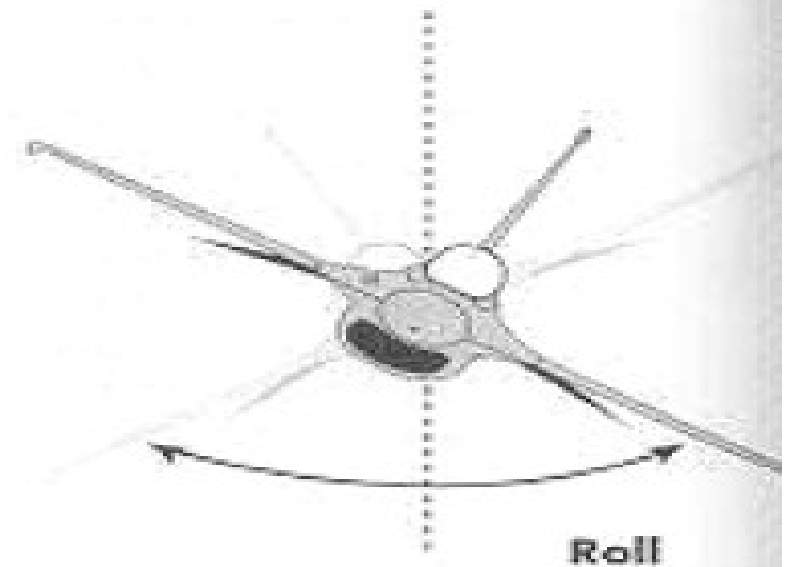
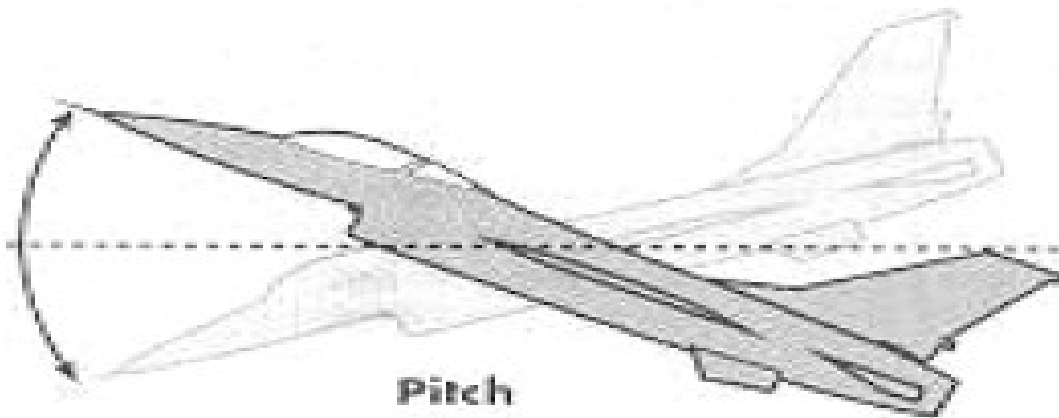
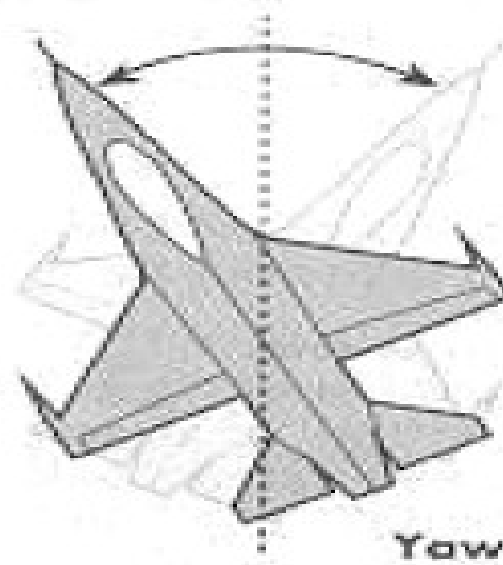
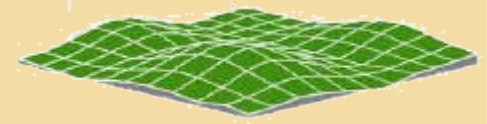
# Aerofotogrametrija

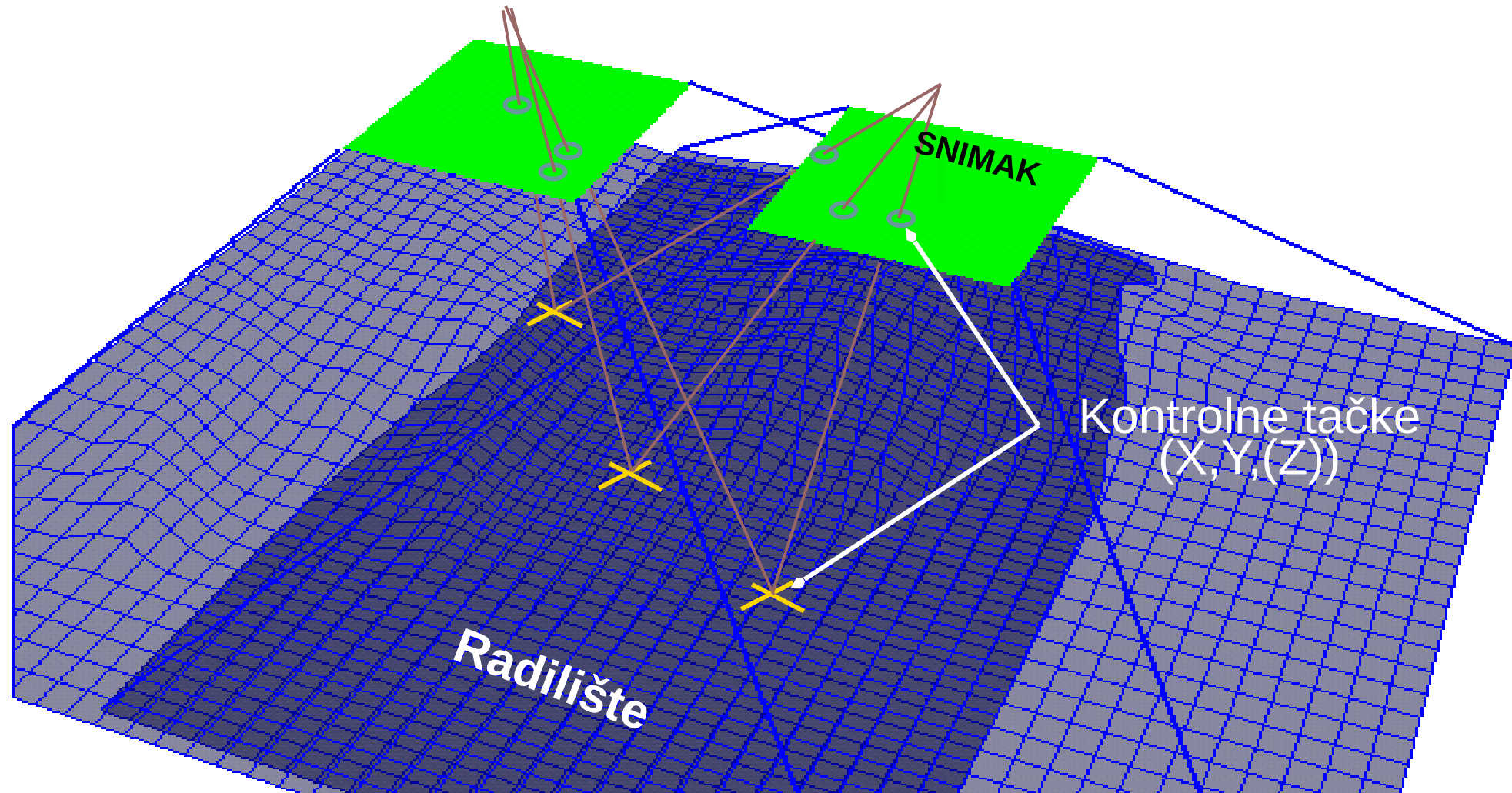
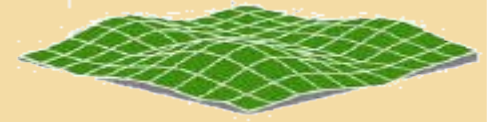


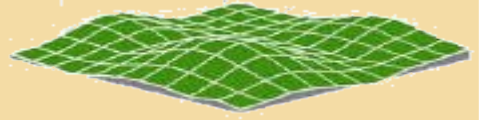


# Aerofotogrametrija

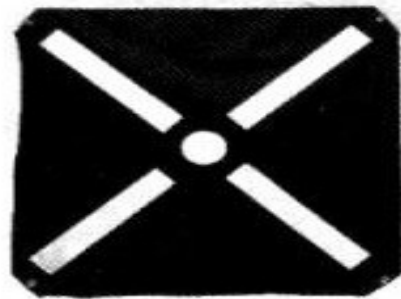




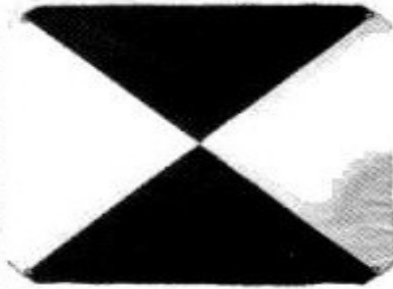




## Aerial Targets

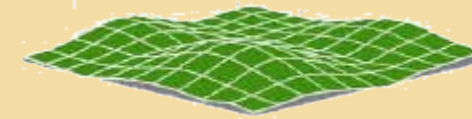


**Bullseye Target**

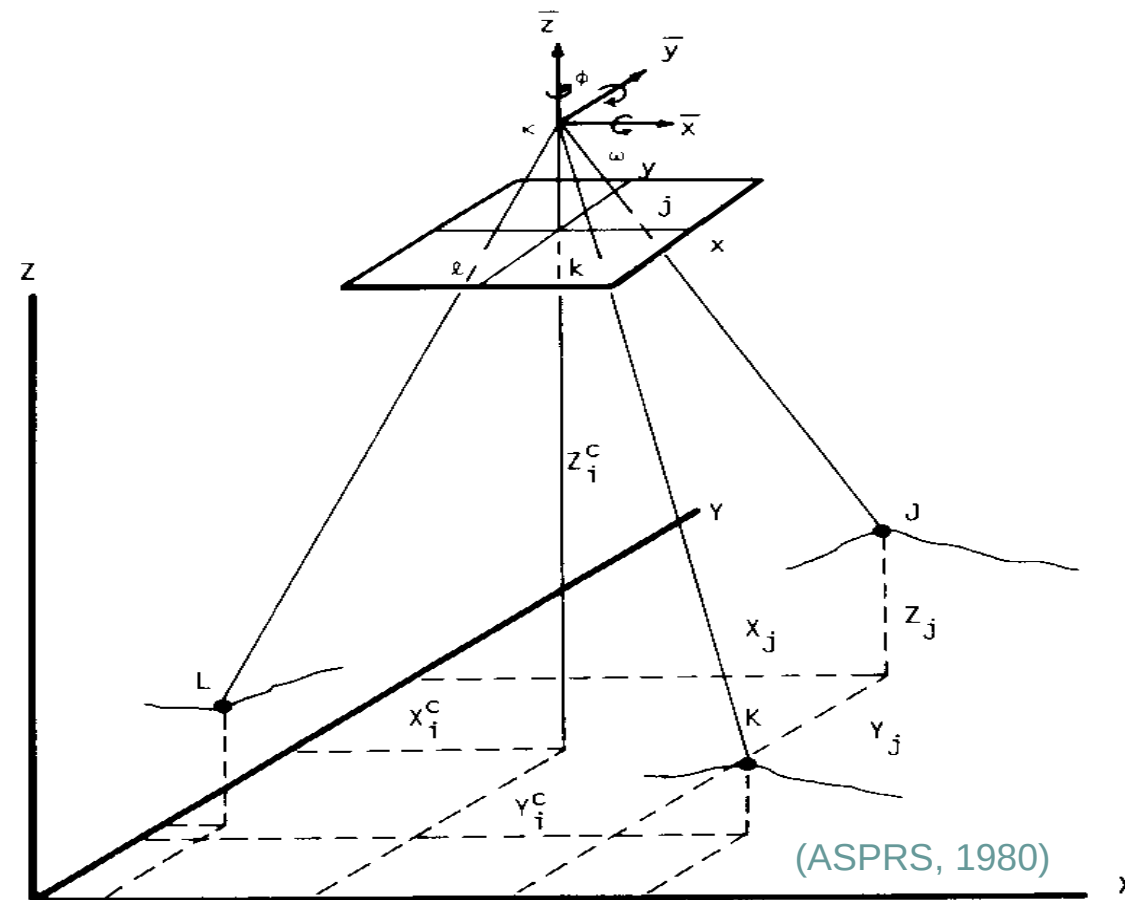


**Iron Cross Target**

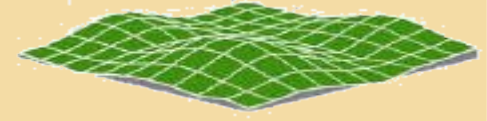
# Spoljna orijentacija

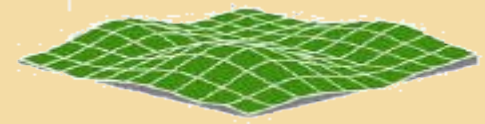


- Određuje položaj i orijentaciju kamere u državnom koordinatnom sistemu na osnovu projekcija kontrolnih tačaka na snimku
- Spoljna orijentacija definiše sve parametre položaja kamere, kao što je položaj centra preslikavanja, pravac optičkih osa i dr.
- Spoljna orijentacija je definisana sa 3 ugla rotacije i 3 parametra translacije



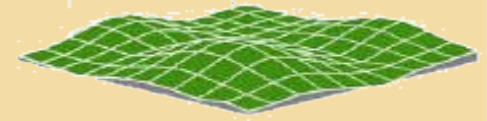
# Glavna tačka snimka



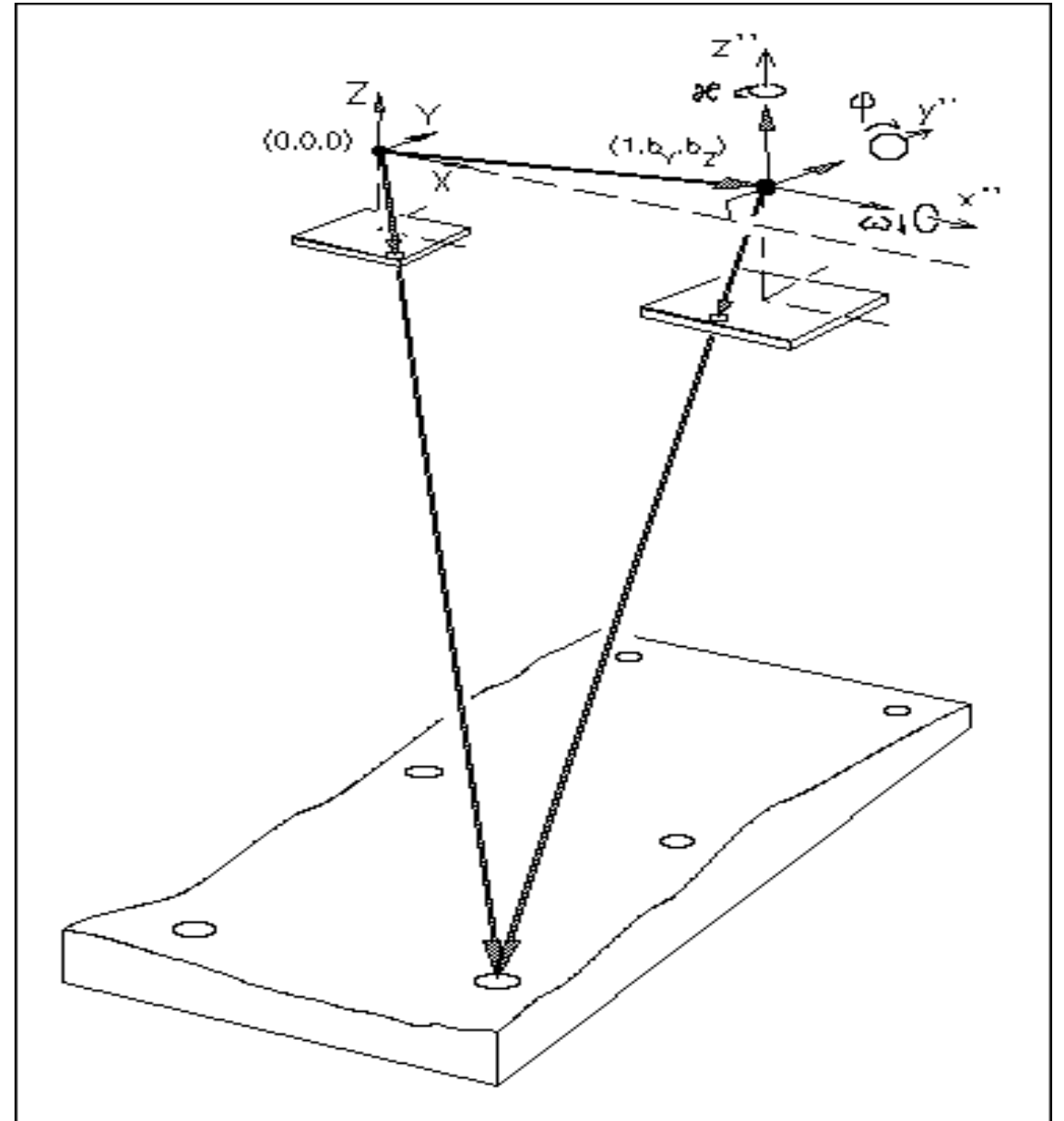


- Određuje unutrašnju geometriju kamere
- Unutrašnja geometrija kamere je data na osnovu svih parametara koji određuju 3D zrake sa merenih slikovnih koordinata
- Parameteri: konstanta kamere, glavna tačka, distorzija sočiva kamere, ...
- Sa unutrašnjom i spoljnom orijentacijom kamera je u potpunosti orjentisana.

# Relativna orijentacija

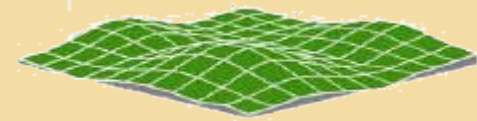


- Definiše relativni položaj dve kamere u trenutku snimanja
- Određuje se na osnovu kontrolnih tačaka i njihovih položaja u modelu
- Podrazumeva unutrašnju orijentaciju svake kamere
- Definisana je sa 5 parametara: 3 ugla rotacije, 2 translacije

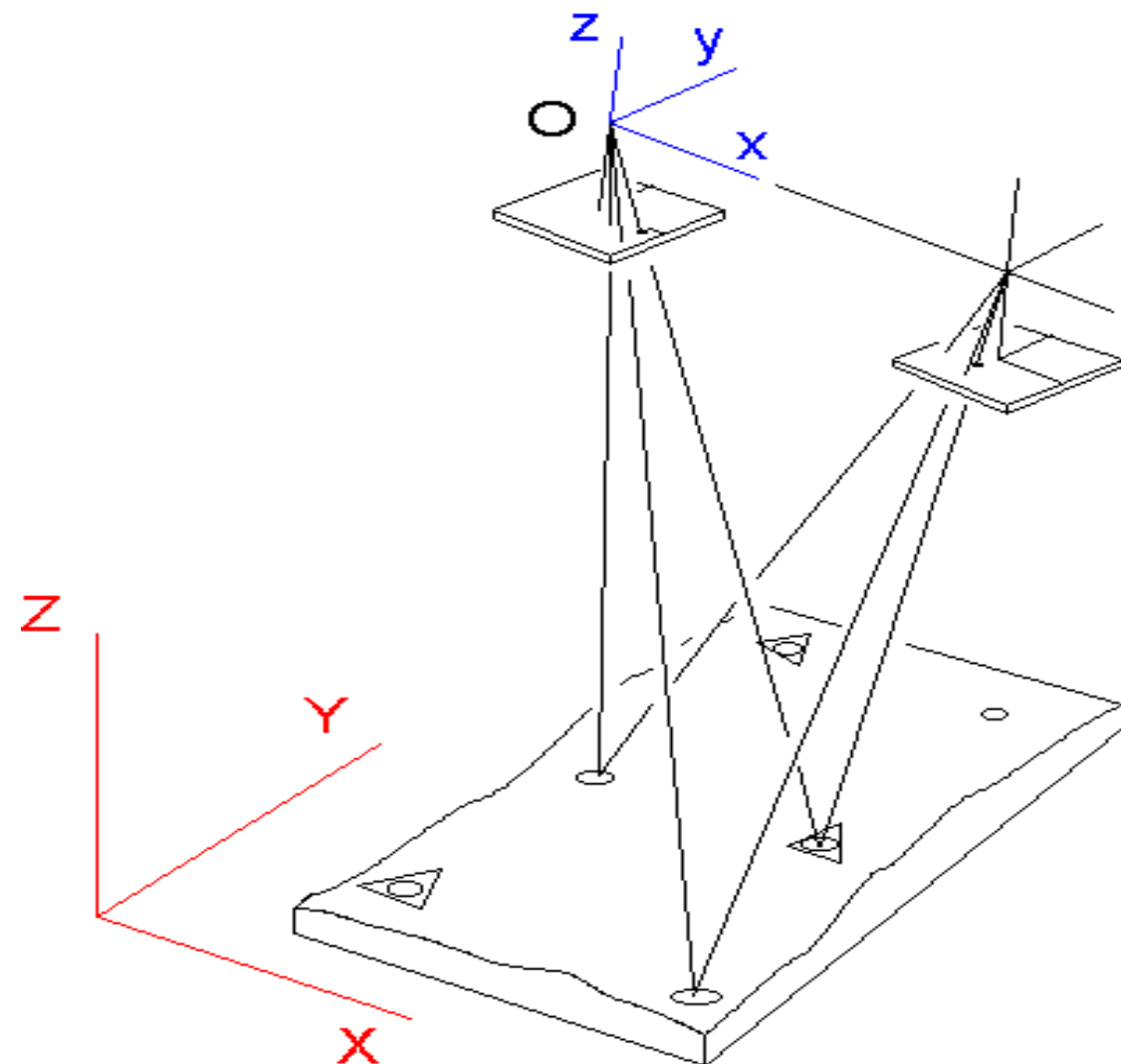




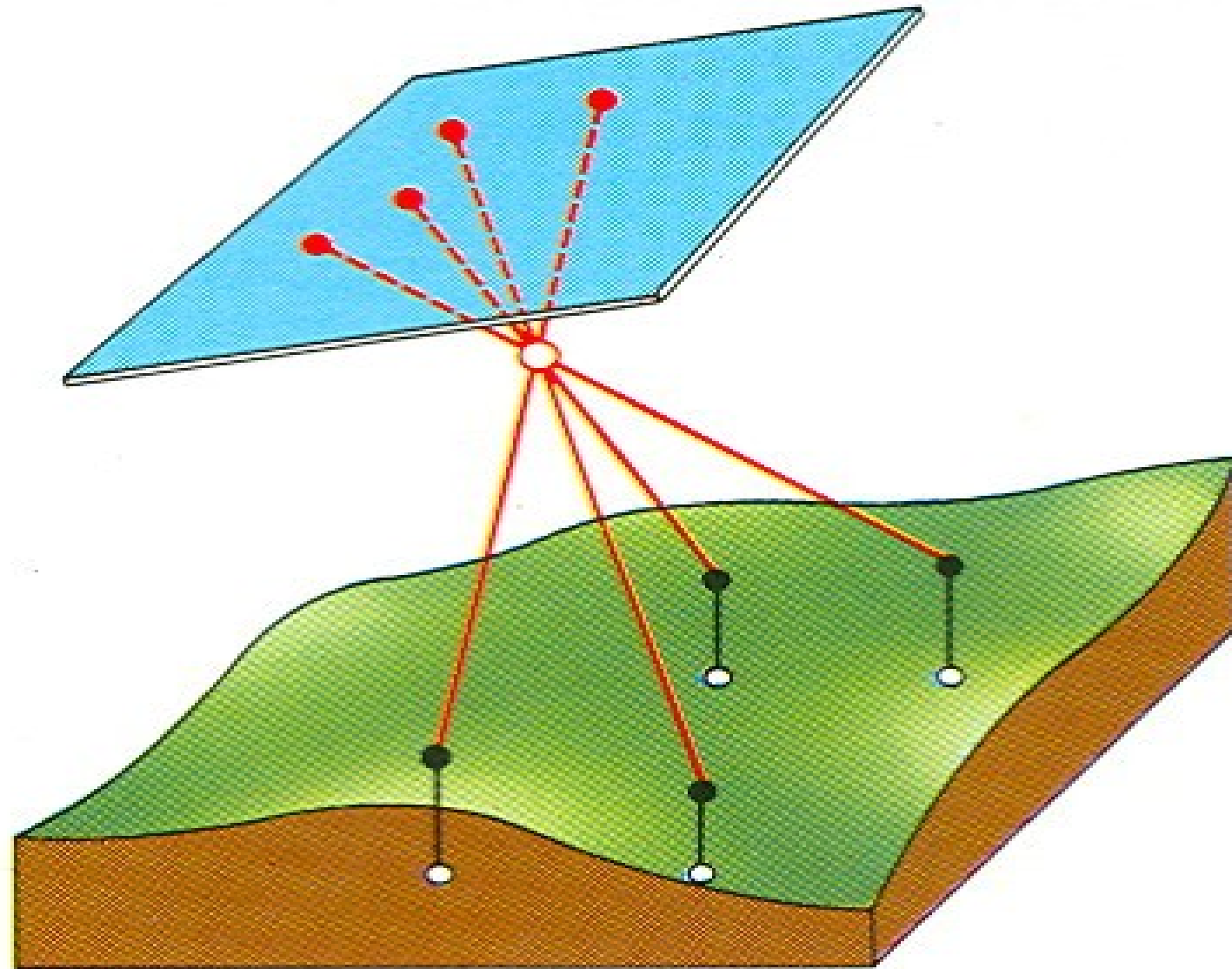
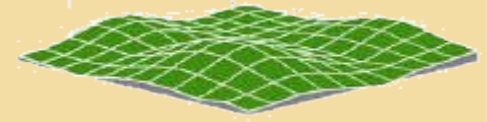
# Apsolutna orijentacija



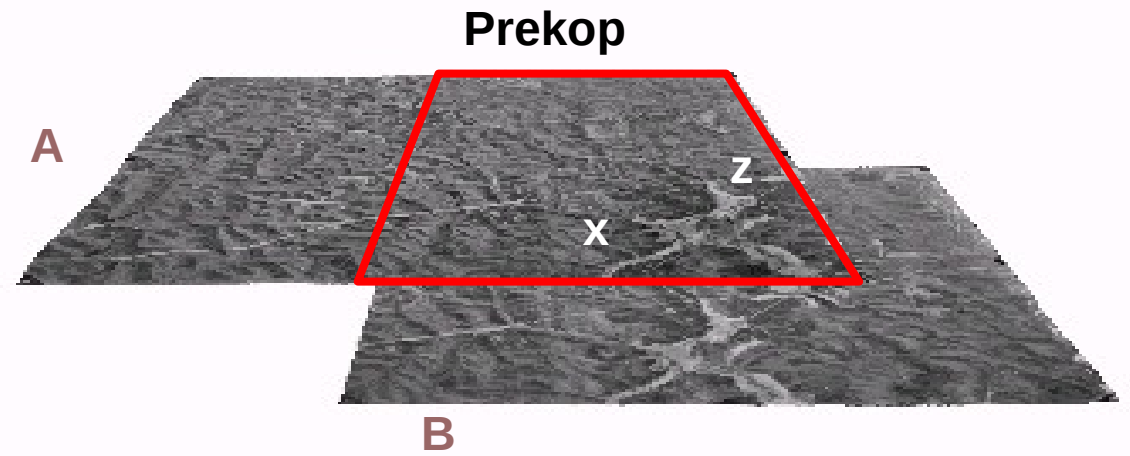
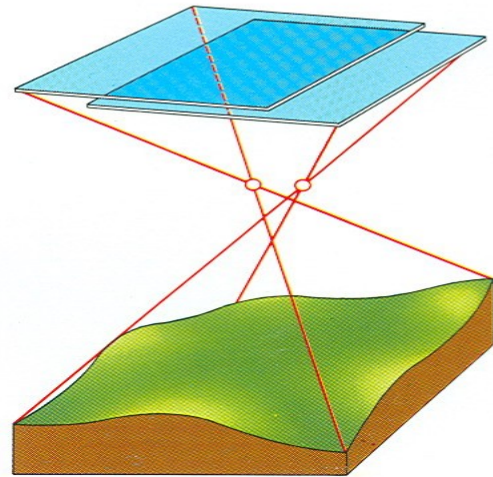
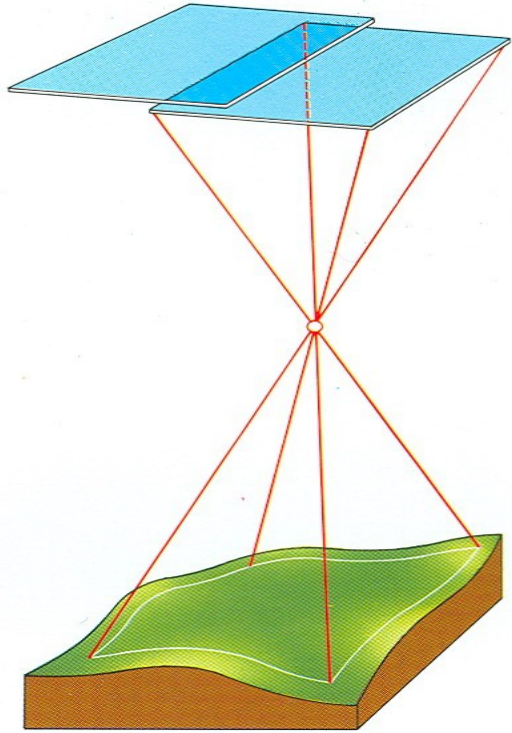
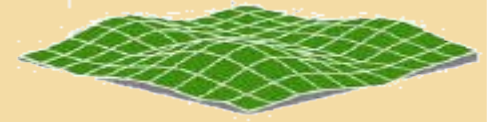
- Određuje transformacione parametre iz modelskog u državni koordinatni sistem
- Definiše razmeru, 3 translacije, 3 rotacije
- Daje vezu između modelskog i državnog koordinatnog sistema



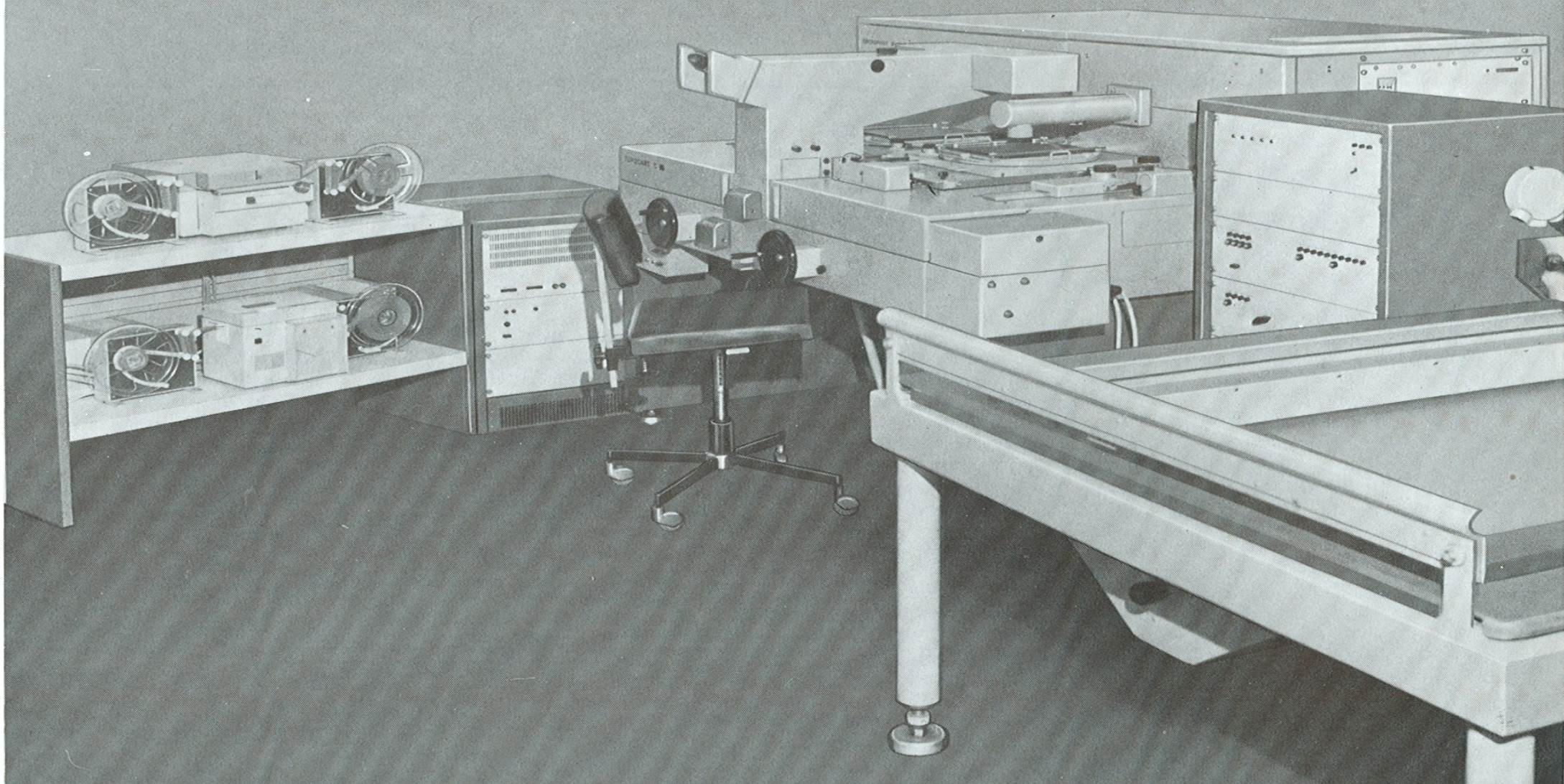
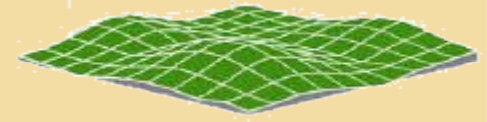
# Centralna projekcija



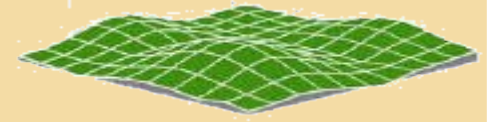
# Model



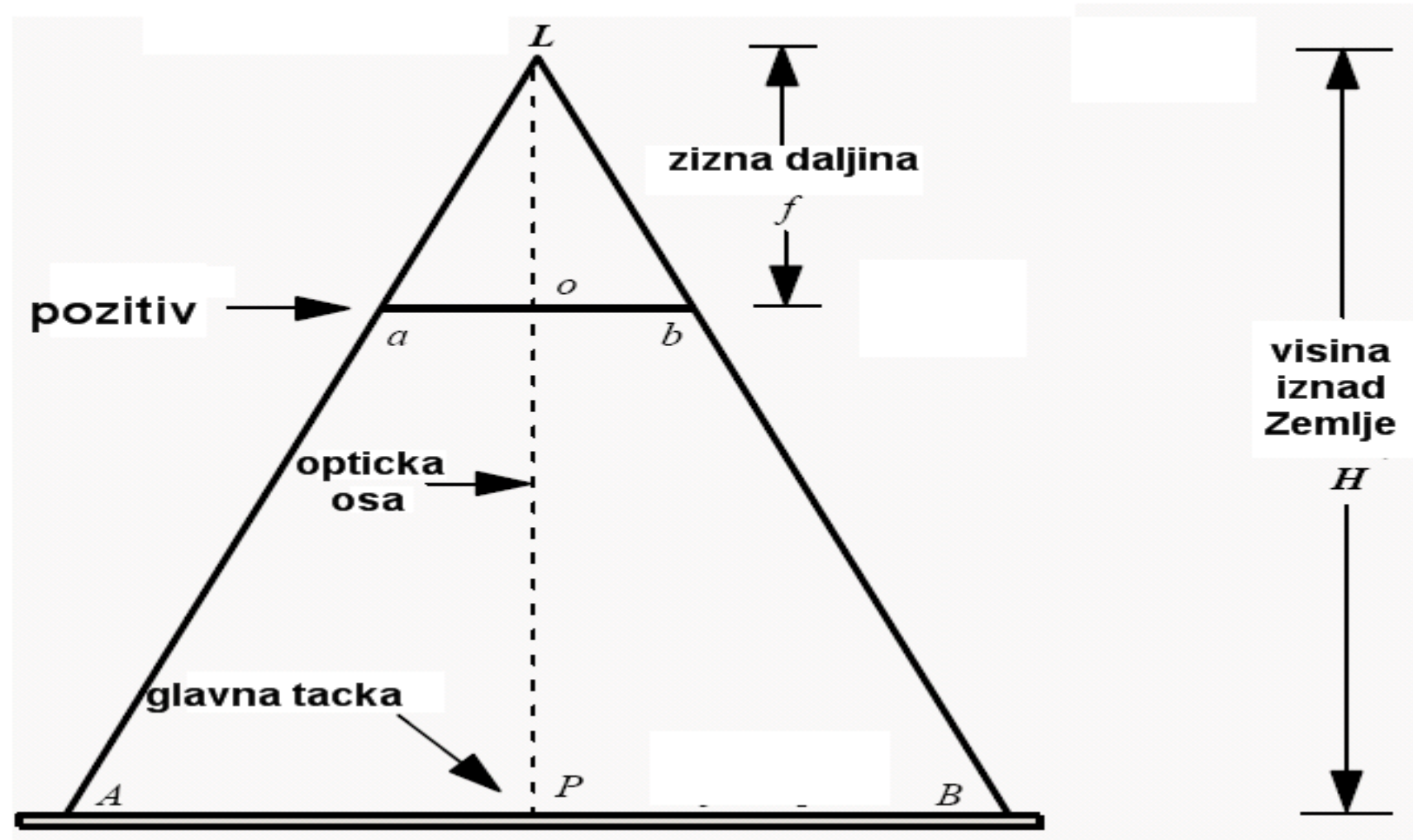
# Stereorestituzioni instrument



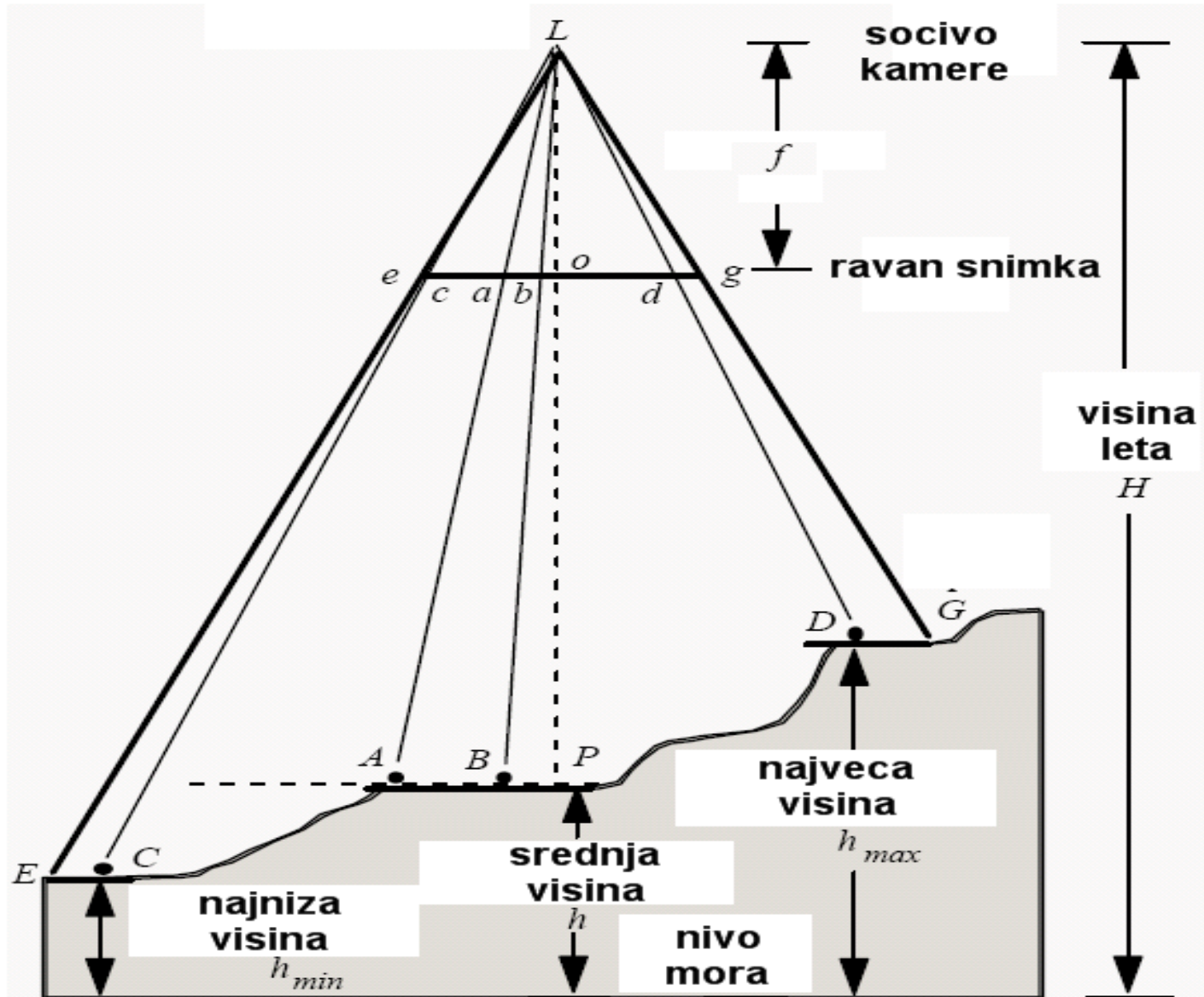
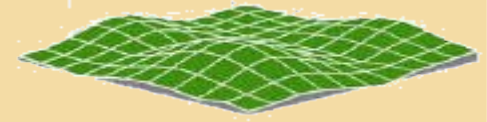
# Ravan teren

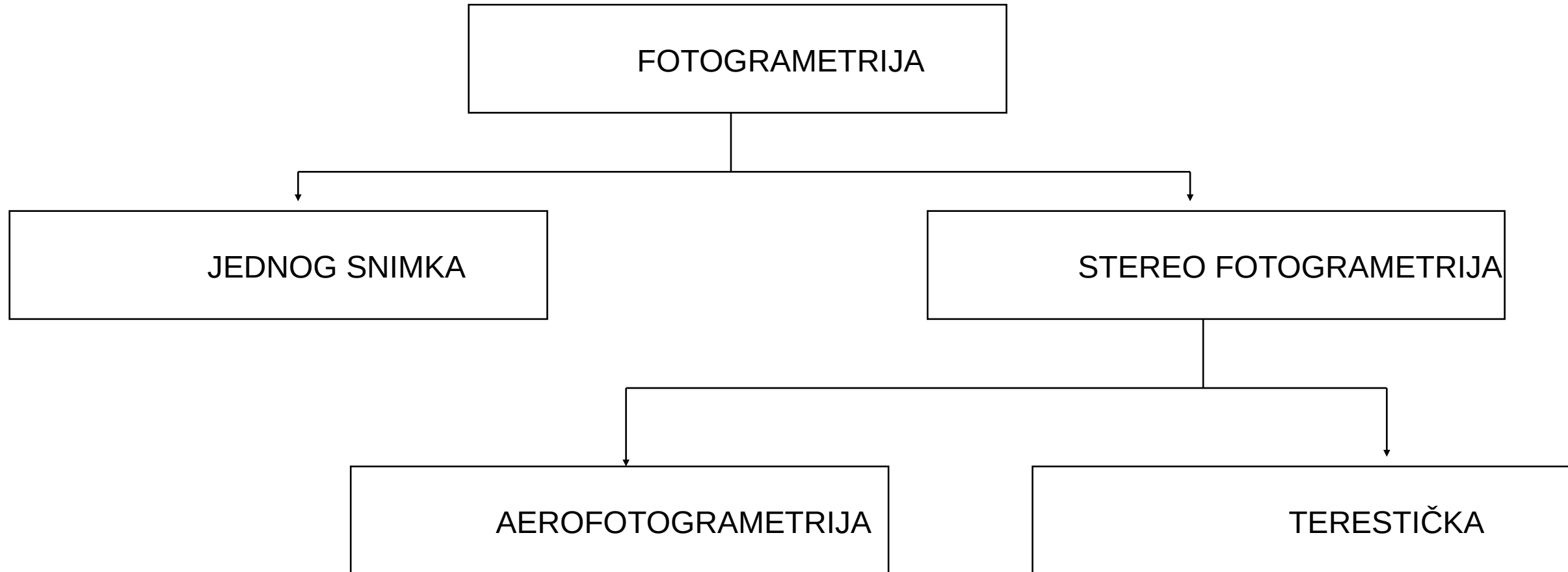
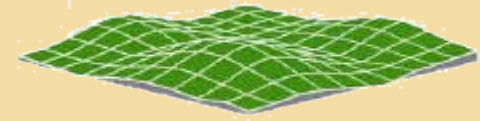


$$\text{razmera} = \frac{f}{H}$$

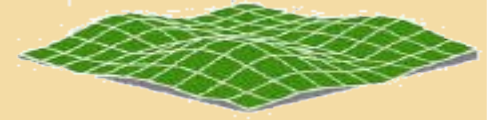


# Neravan teren

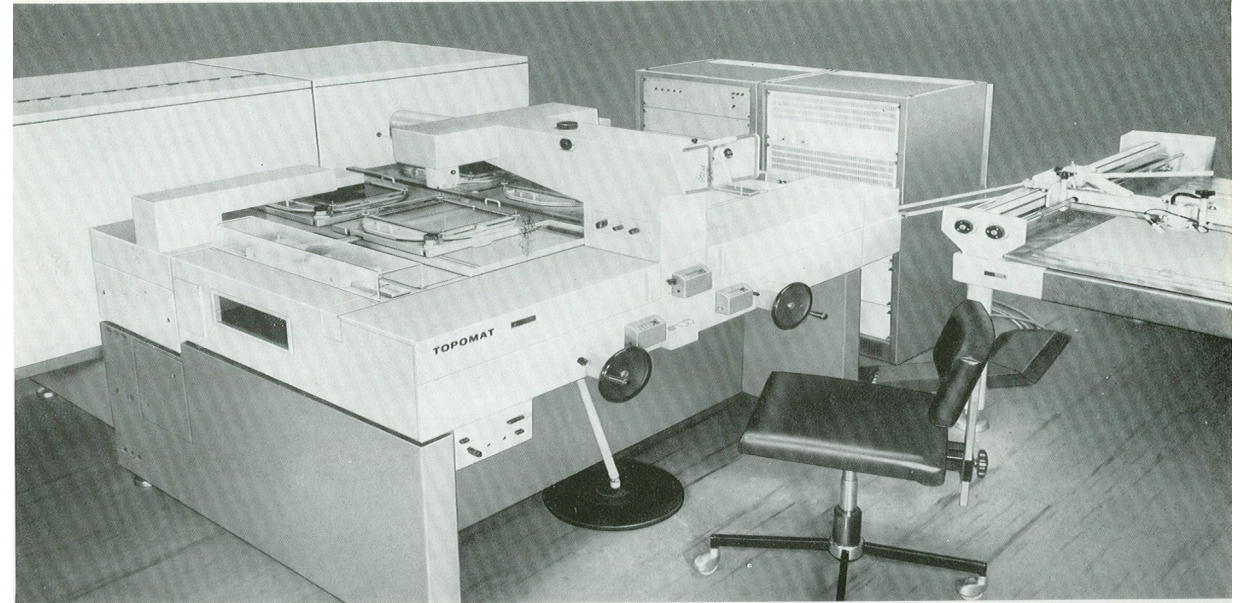




# Podela fotogrametrije prema tehnologiji

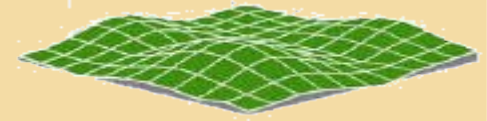


- Analogna,
- Analitička,
- Digitalna.

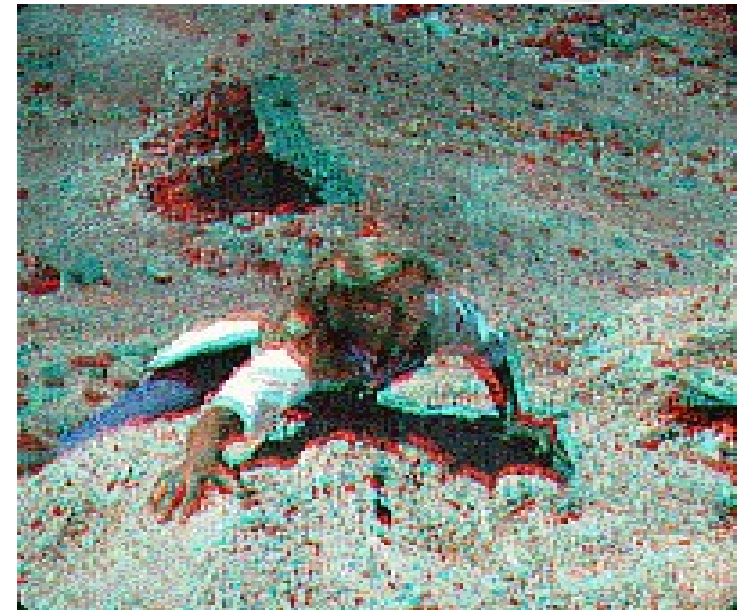


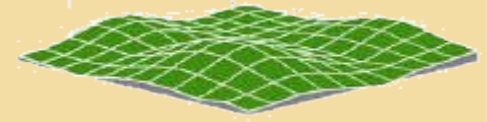


# Anaglifski postupak

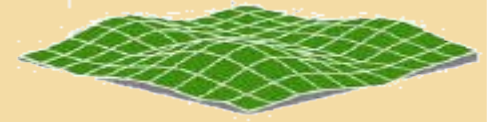


- Konvertuje levi snimak u plavo/zeleno = cijan i desni snimak u crveno
- Prikazuje istovremeno oba snimka kao jednu sliku
- Upotreba naočara sa cijan/crvenim filterima tako da sa jednim okom vidite odgovarajući snimak
- Tehnologija koja je danas već napuštena





- Levo i desno sočivo se otvaraja i zatvaraju sinhronizovano sa prikazima levog i desnog snimka na ekranu



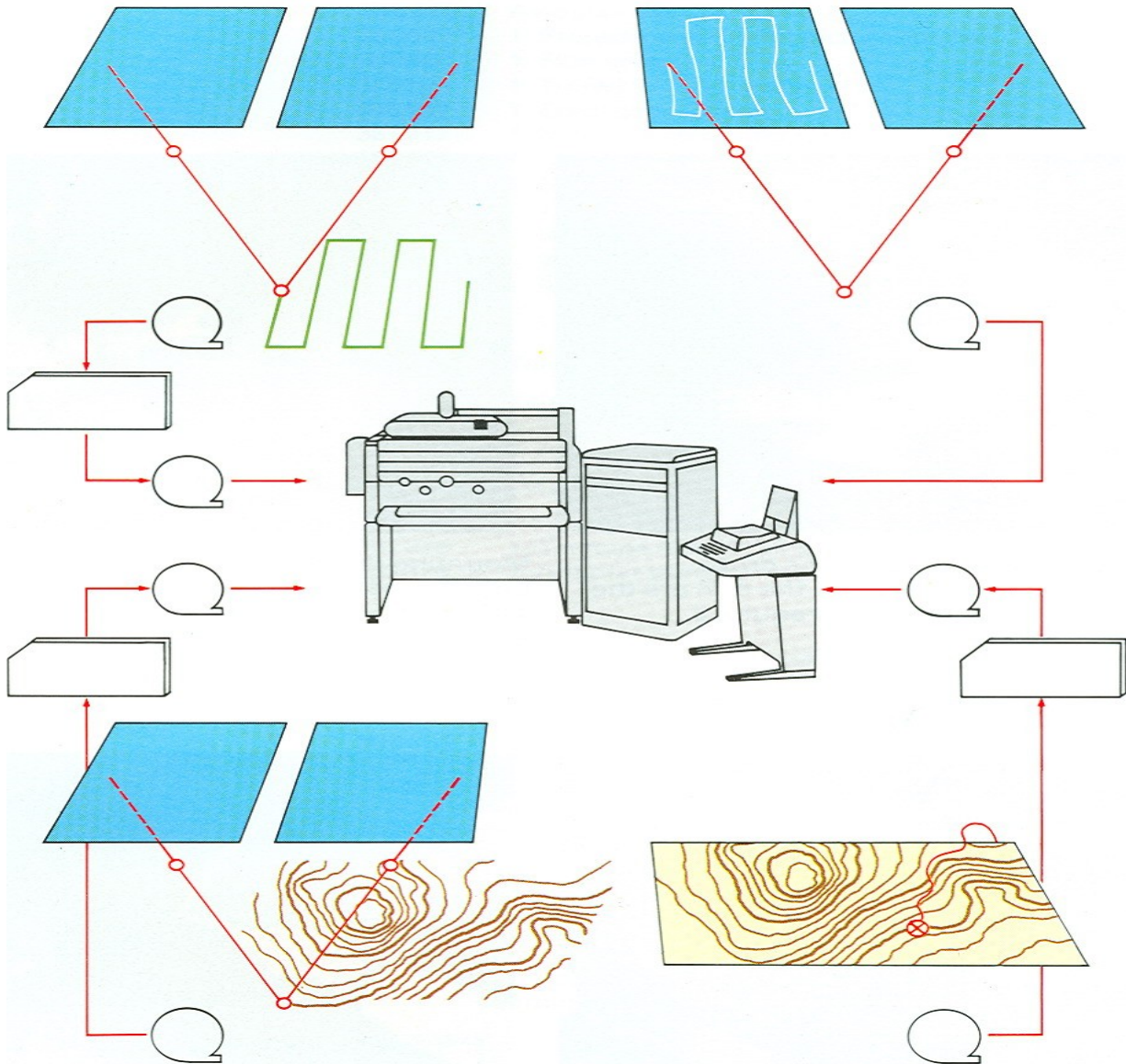
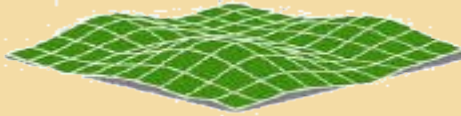
Deo ortofotoplana

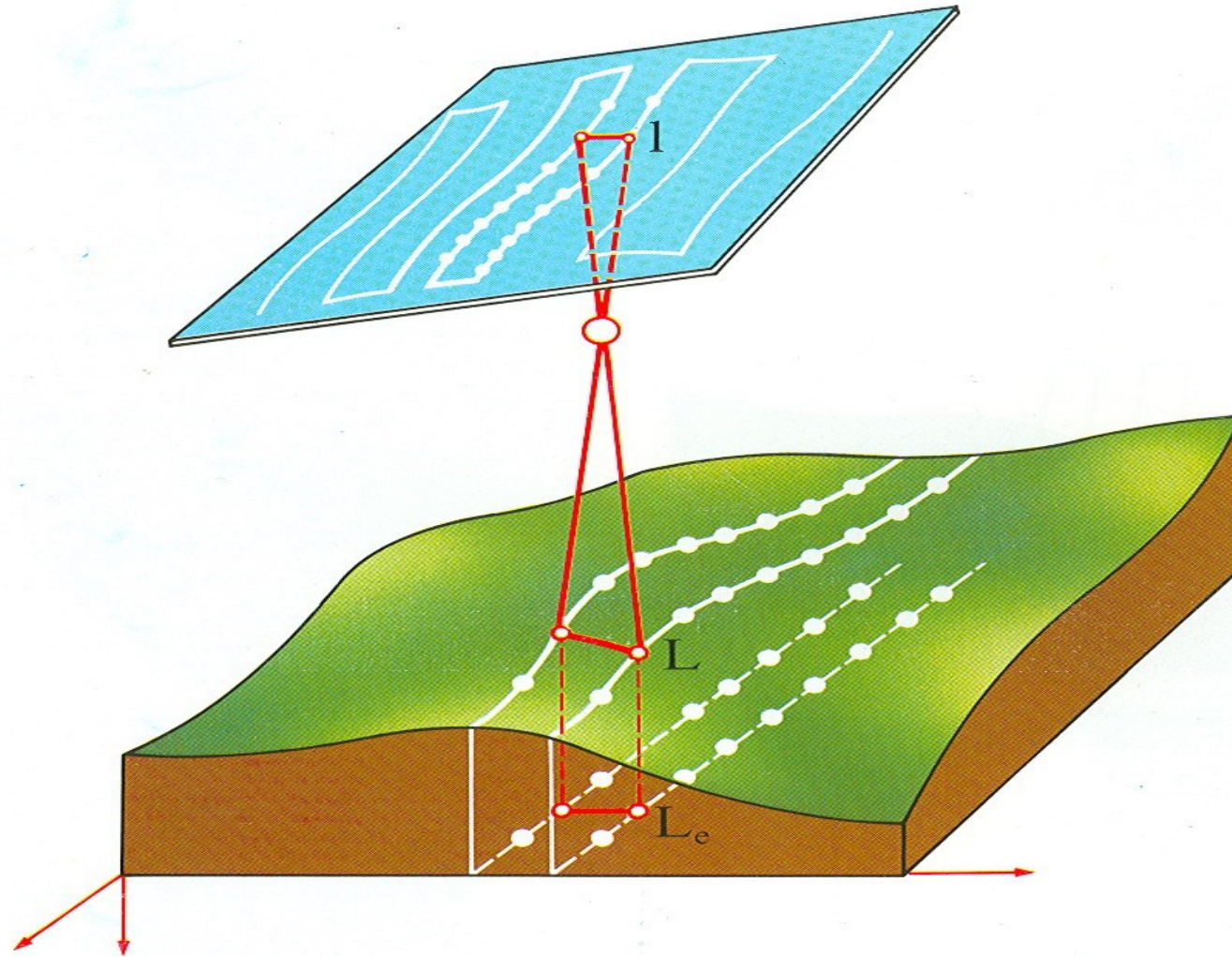
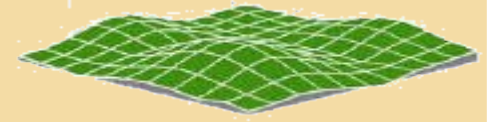


Detalj

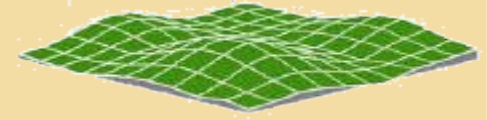


# Visinska predstava





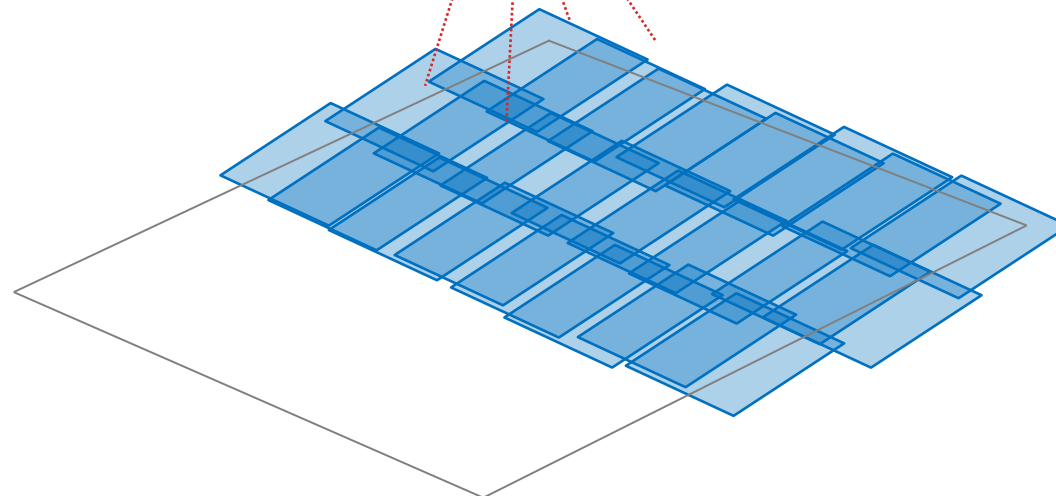
# Bespilotne letelice



## Bespilotni sistemi za fotogrametriju i inspekciju objekata

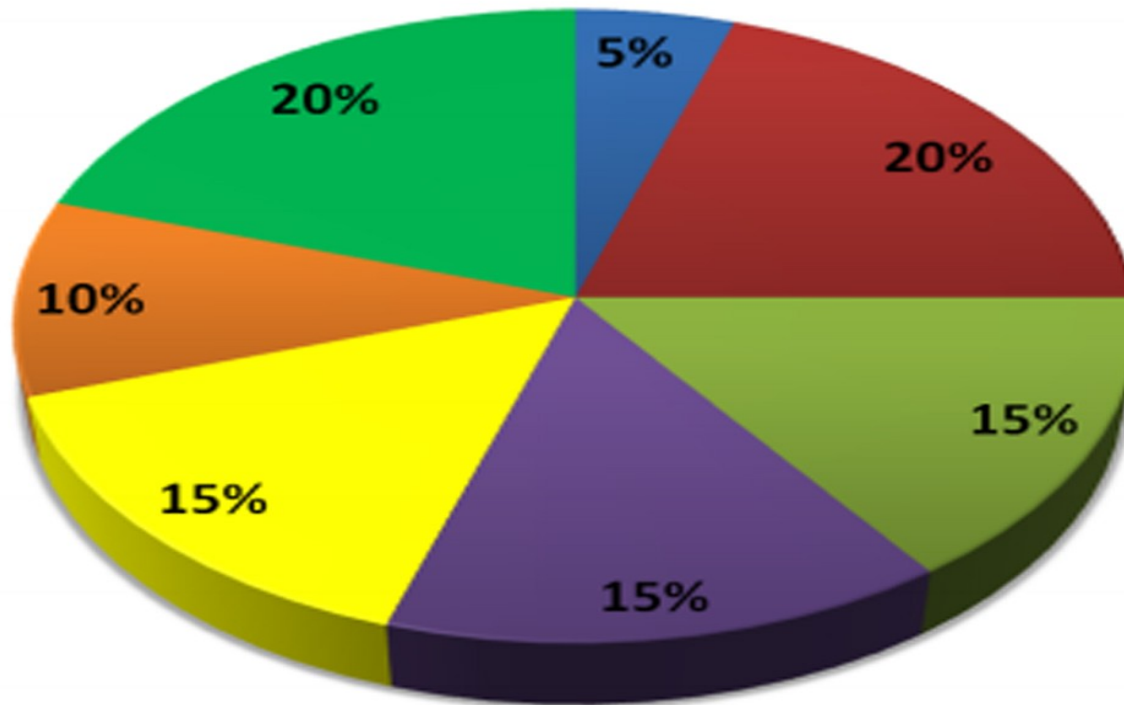
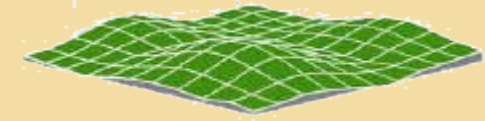


# FULLY AUTOMATED AERIAL SCAN



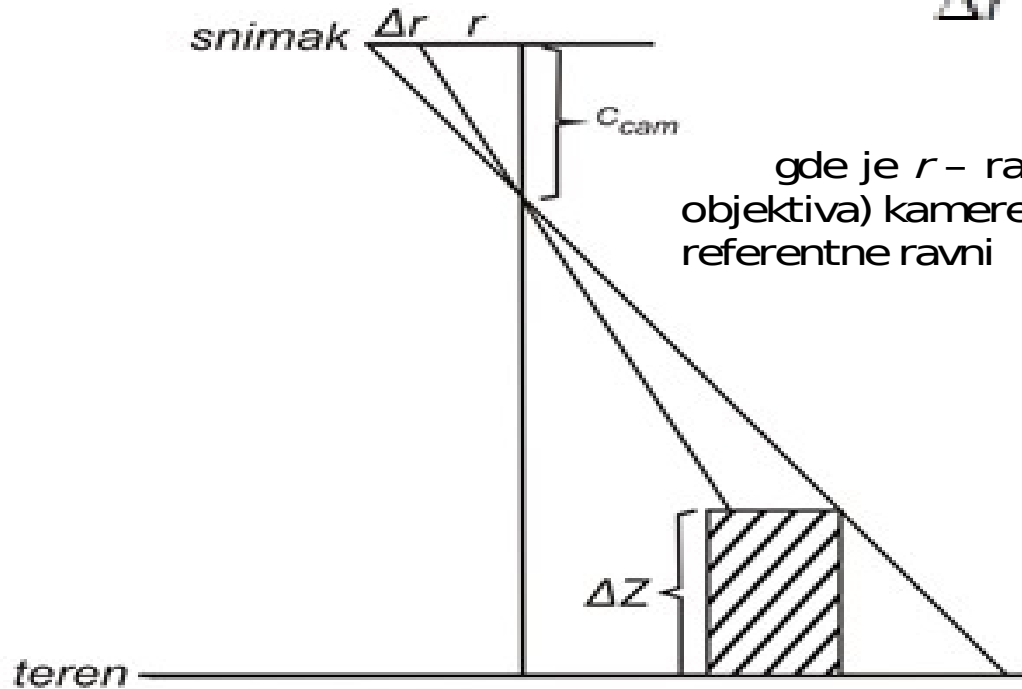
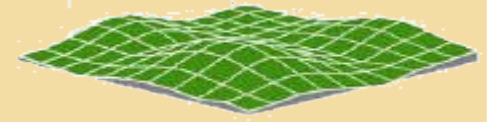
# PRE-PROGRAMMED FLIGHT PLAN





- Planiranje leta
- Snimanje
- Terestička merenja
- Stereo modelovanje
- Izrada DMP-a
- Izrada ortofotoa
- Ekstrakcija objekata





$$\Delta r = \frac{r}{c_{cam} \times M_s} \times \Delta Z$$

gde je  $r$  - radijalno odstupanje tačke od nadira snimka,  $c_{cam}$  - konstanta (žižna daljina objektiva) kamere,  $M_s$  - imenilac razmere snimanja i  $\Delta Z$  - rastojanje gornjih tačaka objekta od referentne ravni

## Radijalna poziciona greška

Rezolucija	Horizontalna tačnost	Vertikalna tačnost
3 cm/piksel	3-6 cm	6-9 cm
5 cm/piksel	5-10 cm	10-15 cm
10 cm/piksel	10-20 cm	20-30 cm
20 cm/piksel	20-40 cm	40-60 cm
30 cm/piksel	30-60 cm	60-90 cm