



engineering and nature
for the needs of
the 21st century

Inženirstvo in narava za potrebe 21. stoletja ▪ Engineering and nature for the needs of the 21st century

Biotehniška fakulteta je v celotnem obdobju delovanja zapisana uporabnim vedam o življenju. Če nekoliko parafraziramo Nejca Zaplotnika, na Biotehniški fakulteti ne pozabljamo, da smo kljub vsem strojem še vedno del narave. Pomembno je, da je Biotehniška fakulteta tudi družbeno odgovorna fakulteta. Naši izobraževalni programi in raziskovalno delo obravnavajo številne družbeno relevantne probleme trajnostnega razvoja, od varne hrane, preskrbe s hrano in skrbi za prostor do sobivanja s prostoživečimi zvermi in problematike rabe lesa. Po nekaj letih zatona inženirstvo v Sloveniji in tudi v EU doživlja neke vrste renesanso.

Okoljski vidik trajnostnega razvoja se pri našem delu kaže v odgovoru na podnebne spremembe, skrbi za biotsko raznolikost, za trajnostno upravljanje kmetijskih površin, za oblikovanje kulture krajine ter tudi v skrbi za varno hrano in preprečevanje (in sanacijo) onesnaževanja okolja. Pridelava hrane danes temelji na uporabi dronov, daljinske zaznave z uporabo raznolikih senzorjev, samovozečih kmetijskih strojev, »big data« ... Te tehnologije danes omogočajo, da zagotavljamo prehransko varnost za rastoče svetovno prebivalstvo in ob tem zmanjšamo pritisk na okolje zaradi ciljne rabe fitofarmaceutskih sredstev, gnojil in razvoja novih sort. Primer zmanjšanja uporabe fitofarmaceutskih sredstev je npr. stroj za medvrstno ožiganje plevela. Skrb za varnost hrane se ne konča pri pridelavi, ampak jo nadgrajujemo z različnimi tehnologijami predelave hrane. Tehnologija s 3D-tiskalniki prihaja tudi v naše kuhinje, s plinskim kromatografom s plamensko ionizacijskim detektorjem (FID) na primer pa lahko ugotavljamo vpliv različnih teh-

noloških postopkov na tvorbo oziroma spreminjanje maščobnokislinskega profila živila. Zaradi želje po zdravem bivanjskem okolju se je zelo razmahnila lesena gradnja. Les je edina surovina, ki jo imamo v Sloveniji v relativnem izobilju, kar omogoča razvoj številnih manjših in večjih podjetij. Sodobna gradnja ne bi bila mogoča brez razvoja nove generacije kompozitov na osnovi nanotehnologije, ki med drugim omogočajo, da gradimo vedno višje lesene nebotečnike. Varnost tem strukturam zagotavljajo sodobne rešitve protipožarne zaščite in modifikacije lesa. Pri tem skrbimo, da so posegi v okolje vzdržni, s čim manjšim vplivom na naravno in kulturno krajino. To skrbno načrtujemo – od risbe preko geoinformacijskih rešitev in izdelave maket, znanje pa v najširšem pomenu besede nato prenašamo v prakso. Okoljski vidik trajnostnega razvoja dopolnjujemo z **ekonomsko učinkovitostjo**. Z BactoScanom npr. hitreje ugotovimo število mikroorganizmov v vzorcih mleka, kar omogoča, da varno mleko hitreje doseže potrošnike. Gozd prekriva skoraj 60 odstotkov Slovenije in je zato naš najbogatejši naravni vir. S podajanjem znanja novim generacijam, raziskovanjem ter sodelovanjem z deležniki na tem področju zagotavljamo trajnostno rabo gozda. Navsezadnje je pomembna tudi **družbena razsežnost** trajnostnega razvoja, ki se pri našem izobraževalnem in raziskovalnem delu izraža v skrbi za korist človeka: od varne hrane do skrbi za prijetno okolje. Vse vidike trajnostnega razvoja dnevno prepletamo in razvijamo z najmodernejšimi tehnologijami ter inženirskimi pristopi. Hitre spremembe na številnih področjih tehnološkega razvoja so zaznamovale drugo polovico 20. in začetek 21. stoletja.

Pričakovati je, da se bo tempo hitrih sprememb še nadaljeval. Številne rešitve, ki so se nam še pred dvajsetimi leti zdele nemogoče, so danes realnost. Biotehniška fakulteta je s svojim znanjem in raziskavami del teh rešitev ter še naprej prednjači tako v slovenskem kot tudi v mednarodnem prostoru.

Biotechnical Faculty has been dedicated to applied life sciences since the very beginnings of its operation. In the words of the late alpinist Nejc Zaplotnik: we at the Biotechnical Faculty never forget that, in spite of all the machines, we are still part of nature. What is important is that the Biotechnical Faculty is also a socially responsible faculty. Our educational programmes and research work address a number of socially relevant issues of sustainable development, from safe food, food supply and care for space to coexistence with wild animals and the issue of wood use. After being in decline for a few years, engineering in Slovenia, like in the EU, is experiencing a sort of renaissance. **The environmental aspect** of sustainable development is reflected in our work in the response to climate change, care for biodiversity, sustainable management of agricultural land, the formation of landscape culture, as well as care for food safety and prevention (and remediation) of environmental pollution. Today, food production is based on the use of drones, remote sensing using various sensors, self-driving agricultural machines, "big data", etc. These technologies now make it possible to ensure food safety for the world's growing population while reducing environmental pressures through the targeted use of phytopharmaceutical products, fertilizers and the development of new varieties. An example of reducing the use of phytopharmaceutical products is the inter-row weed burner machine. The concern for food safety does not end with production, but is upgraded with various food processing technologies. The 3D printing technology is entering our kitchens, and a gas chromatograph with a flame ionization detector (FID), for example, helps us determine the influence of various technological processes on the formation or change of the fatty-acid profile of food. In the desire for a healthy living environment, wood construction has become very popular. Wood is the only raw material in Slovenia that is relatively abundant, and that enables the development of many smaller and larger companies.

Contemporary construction would not be possible without the development of a new generation of composites based on nanotechnology, which, among other things, allow us to build ever taller wooden skyscrapers. The safety of these structures is ensured by contemporary solutions for fire protection and wood modification. In that we make sure that interventions in the environment are sustainable, with the least possible impact on the natural and cultural landscape. We plan the latter carefully – from the drawing and geoinformation solutions to model-making, and then transferring the knowledge into practice, in the broadest sense of the word.

We complement the environmental aspect of sustainable development with **economic efficiency**. For instance, using BactoScan we detect the number of microorganisms in milk samples more quickly, which allows safe milk to reach consumers faster. Almost 60 percent of Slovenia is covered in forests and therefore wood is our richest natural resource. Through the transfer of knowledge to new generations, research and cooperation with stakeholders in this field, sustainable use of forests is ensured.

After all, the **social dimension** of sustainable development is also important, which in our educational and research work is expressed in the concern for the benefit of human beings: from safe food to the care for a pleasant environment. All aspects of sustainable development are intertwined and developed on a daily basis with state-of-the-art technologies and engineering approaches.

There were significant and rapid changes in many areas of technological development in the second half of the 20th and the beginning of the 21st century. The pace of these rapid changes is expected to continue. Many solutions that seemed impossible merely twenty years ago are a reality today. With its knowledge and research, the Biotechnical Faculty is part of these solutions and continues to take the lead both in Slovenia and internationally.

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Odprti bazeni z mikroalgami

V rastlinjaku Oddelka za agronomijo gojimo mikroalge v okviru evropskega projekta Water2REturn, katerega namen je predstaviti inovativne tehnologije za čiščenje odpadnih voda. Z gojenjem mikroalg na odpadnih vodah lahko recikliramo do 95 odstotkov dušika in fosforja, ki ju med klasičnimi postopki čiščenja izgubimo v obliki plinov in blata. Mikroalge predelamo v novonastala gnojila in biostimulanse ter tako sledimo zakonitostim krožnega gospodarstva: odpadna rastlinska hranila ponovno uporabimo pri pridelavi hrane. Ker so mikroalge fotosintetski organizmi, vzgoja mikroalg predstavlja tudi velik potencial za zmanjšanje izpustov toplogrednega plina ogljikovega dioksida. Mikroalge so vir rastlinskih makro- in mikroelementov, aminokislin in fitohormonov, zato pripravki iz mikroalg omogočajo boljšo rast, razvoj in večjo odpornost rastlin.

Outdoor microalgae basins ▪ In the greenhouse of the Department of Agronomy, microalgae are grown as part of the European project Water2REturn, which aims to present innovative technologies for wastewater treatment. By growing microalgae in wastewater, we can recycle up to 95 percent of the nitrogen and phosphorus which during conventional treatment processes are lost in the form of gases and sludge. Microalgae are processed into newly formed fertilizers and bio stimulants, thus following the principles of circular economy: waste plant nutrients are reused in food production. As microalgae are photosynthetic organisms, the cultivation of microalgae also represents a huge potential for reducing greenhouse gas emissions of carbon dioxide. Microalgae are a source of plant macro- and microelements, amino acids and phytohormones, and so microalgae preparations help with better growth, development and greater resistance of plants.



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Stroj za medvrstno ožiganje plevela

Na fotografiji je stroj za medvrstno ožiganje plevela. Stroj omogoča zatiranje plevelov na nekemičen način, to je brez uporabe fitofarmacevtskih sredstev. Stroj s plinom ožge površino rastlin, zaradi česar rastlinske celice popokajo in rastlina propade. S strojem obdelujemo samo medvrstni prostor, to je prostor, na katerem gojene rastline ne rastejo, in na ta način uničujemo plevela na sonaraven in okolju prijazen način. Pomembne prednosti ožiganja plevela so, da ne poškodujejo strukture zemlje in organizmov v zemlji, poleg tega pa je primerno za ekološko kmetovanje. Ožiganje se uporablja za zatiranje plevela na njivah in v zelenjadarstvu, prav tako za ožiganje poti v trajnih nasadih, npr. med trtami in sadnim drevjem.

Inter-row weed burner machine ▪ The photo shows an inter-row weed burner machine. The machine allows weed control in a non-chemical way, i.e. without the use of plant protection products. The machine burns the surface of the plants with gas, causing the plant cells to burst and the plant to perish. The machine is only used to treat the inter-row space, i.e. the space where cultivated plants do not grow, and in this way the weeds are destroyed in a sustainable and environmentally friendly way. The important advantage of weed burning is that they do not damage the structure of the soil and the organisms in the soil, and moreover, it is suitable for organic farming. Burning is used to control weeds in fields and in vegetable growing, as well as to burn pathways in permanent plantations, e.g. between vines and fruit trees.



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Brezpilotni letalniki ali droni

Brezpilotni letalniki ali droni vse bolj vstopajo tudi v kmetijsko dejavnost, pri čemer so lahko učinkovito orodje za hiter in velikopovršinski nadzor posevkov in nasadov, vse pogostejša je tudi njihova uporaba kot agrotehničnih strojev za nanos škropiv, biostimulansov in foliarnih gnojil. Na Oddelku za agronomijo uporabljamo dron kot nosilno platformo za običajno in multispektralno kamero, s katerima med drugim vrednotimo posevke v različnih poljskih poskusih. Zanimata nas natančnost, s katero lahko zajamemo stanje posevka (fenofaza, višina, gostota, zapleveljenost), ter njegov odziv na okoljske dejavnike, kot so razpoložljivost hranil, suša ter interakcija suše z značilnostmi tal. Za ta namen posnetke z drona validiramo s kontaktnimi meritvami na kmetijskih rastlinah.

Unmanned aerial vehicles or drones ▪ Unmanned aerial vehicles or drones are increasingly entering the agricultural sector, being an effective tool for rapid and large-scale control of crops and plantations, and their use as agrotechnical devices for the application of sprays, bio stimulants and foliar fertilizers. At the Department of Agronomy, we use a drone as a carrying platform for conventional and multispectral cameras, with which, among other things, we evaluate crops in various field experiments. What interests us is the accuracy with which we can capture the condition of the crop (phenophase, height, density, weeding), and its response to environmental factors such as nutrient availability, drought, and the interaction of drought with soil characteristics. For this purpose, drone images are validated through contact measurements on agricultural plants.



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Preskus odziva na ogenj

V zadnjih letih je po statističnih podatkih zaznati poslabšanje požarne varnosti v stavbah. Požarne lastnosti gradbenih materialov so ključne za zagotavljanje požarne varnosti v stavbah. Kljub temu da je les gorljiv material, je njegovo obnašanje v primeru požara predvidljivo. Pri gorenju lesa se sprošča tudi veliko manj dima kot pri gorenju umetnih materialov na osnovi ogljikovodikov, kar omogoča lažjo evakuacijo ljudi v primeru požara. Les lahko obdelamo z zaviralci gorenja in s tem naredimo les težje vnetljiv. V fazi razvoja in med proizvodnjo je testiranje takšnega lesa ključno za zagotavljanje ustrezne zaščite. Uporabljena metoda: Preskusi odziva na ogenj – Sposobnost vžiga gradbenih proizvodov v neposrednem stiku s plamenom – 2. del Preskus z enim gorilnikom (SIST EN 11925-2: 2011).

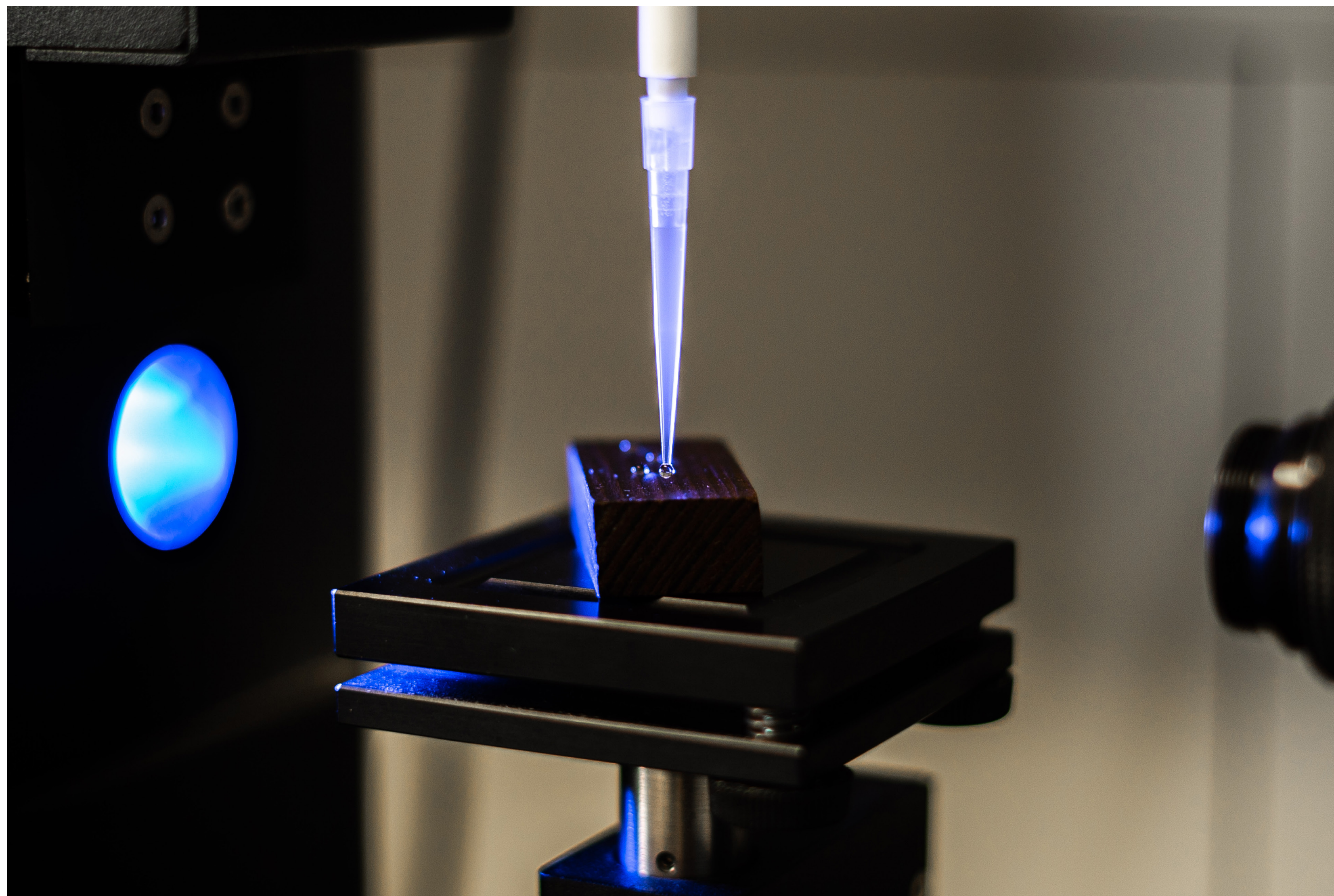
Fire response test ▪ In recent years, according to statistics, deterioration in fire safety in buildings has been detected. The fire properties of building materials are key to ensuring fire safety in buildings. Even though wood is a flammable material, its behaviour in case of fire is predictable. Burning wood also emits much less smoke than burning hydrocarbon-based plastics, making it easier to evacuate people in the event of a fire. Wood can be treated with flame retardants, which makes it less flammable. During the development phase and during production, testing such wood is crucial to ensure adequate protection. Method used: Fire response tests – Ability of ignition of construction products in direct contact with flame – Part 2: Single burner test (SIST EN 11925-2: 2011).



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Optični tenziometer

Les je po naravi hidrofilen material, kar pomeni, da absorbira vodo. To glede uporabe predstavlja eno izmed njegovih negativnih lastnosti, saj lahko vlaženje materiala povzroči spremembe barve, dimenzij, nastanek razpok in omogoča začetek razkroja lesa. Po drugi strani ta lastnost omogoča bolj ali manj uspešno površinsko obdelavo, s katero je možno izboljšati nekatere lastnosti lesa. Z napravo na fotografiji ugotavljamo, kakšen je stični kot vode na lesu. Glede na spremembo oblike kapljice lahko določimo hidrofobnost površine. Meritve s to napravo so torej pomembne pri izboljševanju postopkov površinske obdelave lesa, določanju njegove življenjske dobe in razvoju novih materialov.

Optical tensiometer • Wood is a hydrophilic material by nature, which means that it absorbs water. This is one of its negative properties in terms of use, as wetting the material can cause changes in colour, dimensions, the formation of cracks and enables the start of wood decay. On the other hand, this property allows more or less successful surface treatment, which can improve some properties of wood. With the device illustrated, the contact angle of water on wood is determined. Based on the droplet reshape, the hydrophobicity of the surface can be determined. Measurements with this device are therefore important in improving wood surface treatment, in determining its lifespan and in development of new materials.



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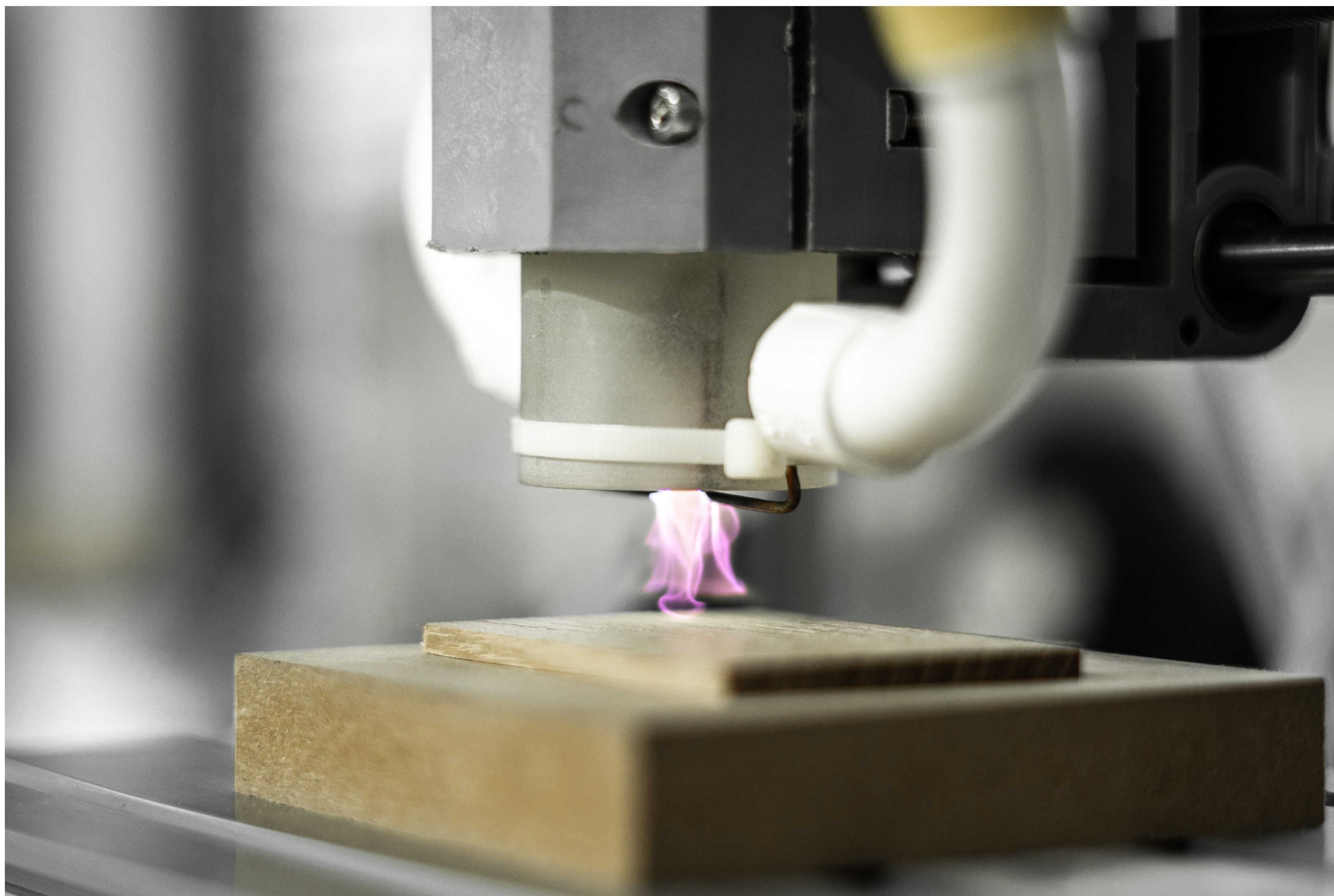
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Obdelava površin lesa s plazmo

Plazma kot četrto agregatno stanje snovi je prisotna v naravi, a jo lahko ustvarimo tudi umetno, in sicer z ustvarjanjem električnega polja v zraku ali ob prisotnosti določenega plina. Izpostavitve trdnih materialov plazmi povzroči kemijske spremembe na njihovih površinah. Posledica reakcij med površinami materialov in plazemskimi delci je med drugim izboljšana kompatibilnost s tekočinami. V tehnologiji to s pridom izkoriščamo na primer pri nanosu tekočih lepil in premazov na površino lesa. Obdelava lesa s plazmo tako prispeva k boljši omočljivosti površin lesa ter tudi k povečani adheziji lepil in premazov s substratom.

Plasma surface treatment of wood surfaces • Plasma as the fourth state of matter is present in nature, but it can also be created artificially, namely by creating an electric field in the air or in the presence of a certain gas. Exposure of solid materials to plasma causes chemical changes in their surfaces. Reactions between material surfaces and plasma particles result in, among other things, improved compatibility with liquids. In technology, we make good use of this, for instance, when applying liquid adhesives and coatings to the wood surface. Plasma wood treatment thus contributes to better wetting of wood surfaces as well as to increased adhesion of adhesives and substrate coatings.



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BactoScan

BactoScan je instrument, ki se uporablja v mlekarstvu in je namenjen neposrednemu štetju bakterij v surovem mleku, s čimer preverjamo higiensko kakovost surovega mleka. Ta je zelo pomembna, saj nam povišano število mikroorganizmov v mleku sporoči, da je mleko higiensko oporečno (bolna žival, slaba higiena rokovanja z mlekom med molžo in po njej)). BactoScan deluje po načelu pretočne citometrije. To je hitra rutinska metoda, pri kateri dobimo rezultat v nekaj minutah, kar je velika prednost pred referenčno metodo štetja bakterij z gojenjem na trdem gojišču, pri kateri za rezultat potrebujemo tri dni.

BactoScan • BactoScan is an instrument used in dairy farming and intended for direct counting of bacteria in raw milk, thus checking the hygienic quality of raw milk. This is very important, as the increased number of microorganisms in the milk can tell us if the milk is hygienically unsafe (sick animal, poor hygiene of handling the milk during and after milking). BactoScan operates on the principle of flow cytometry. It is a quick routine method which gives us the result in a few minutes, which is a big advantage over the reference method of bacteria counting by growing them on a solid medium, where it takes three days to get the result.



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Kako pomolsti kozo in pridobiti kakovostno mleko?

Na fotografiji so koze med strojno molžo na molzišču. Molža koz je dokaj enostaven postopek, še posebej če imamo molzišče in molzni stroj, s katerim prihranimo ogromno časa in napora v primerjavi z ročno molžo. Koze pridejo na dvignjeno molzišče prostovoljno, saj se radi vzpenjajo. Privabimo jih tudi z močnimi krmili, ki jih dobijo samo med molžo. Molzemo jih enkrat do dvakrat na dan, odvisno od dnevne količine mleka. Namolzeno mleko potuje po mlekovedu, ki je popolnoma zaprt sistem, iz kozjega vimena do hladilnega bazena in tako ne pride v stik s hlevskim zrakom in se ne navzame vonja »po kozah«. Hladilni bazen je postavljen v prostoru, ločenem od hleva, kar zagotavlja popolno higieno mleka. Kozje mleko je naravno homogenizirano, ker so maščobne kroglice manjše kot v kravjem mleku. Smetana se iz kozjega mleka ne izloča.

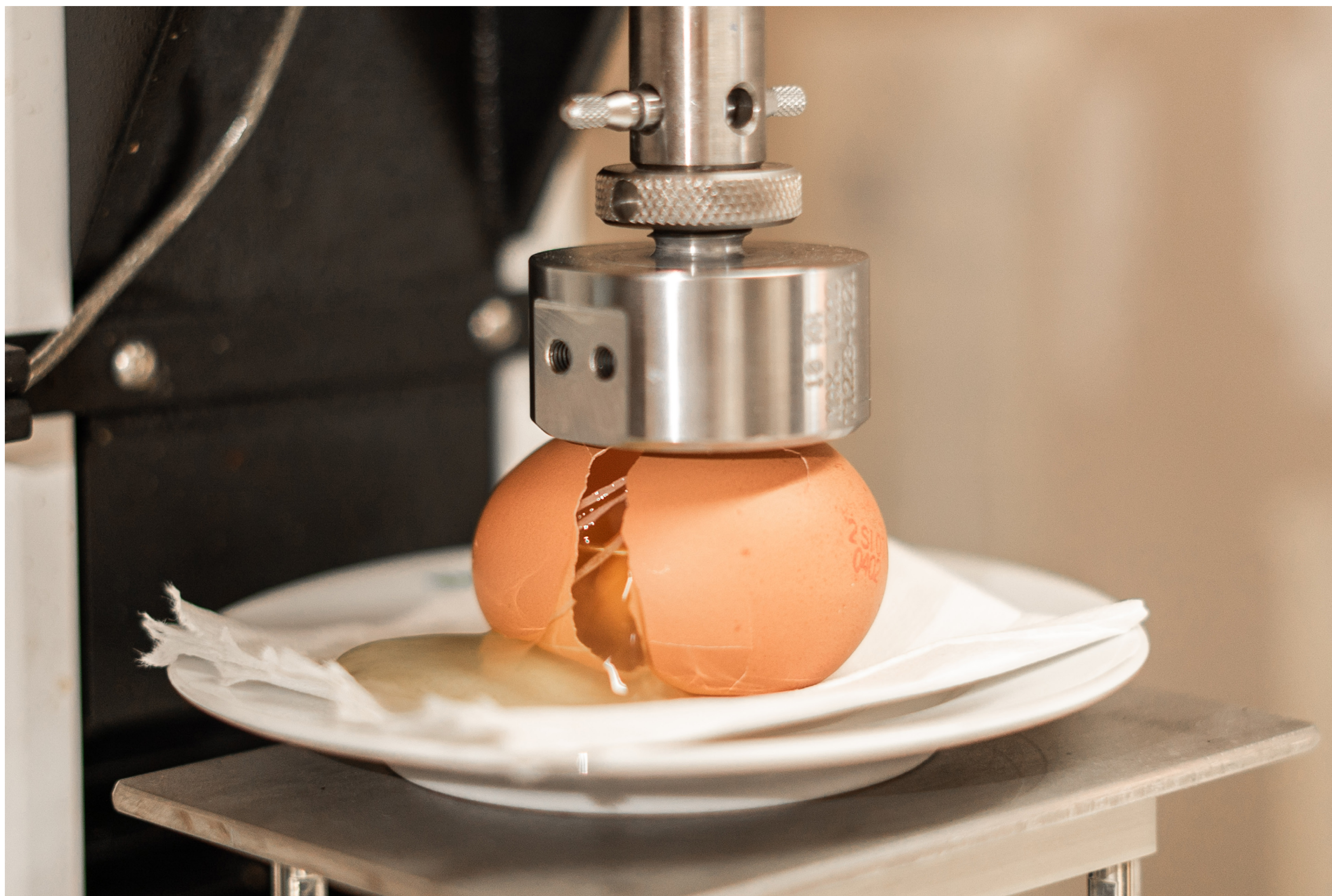
How to milk a goat and get quality milk? ▪ The photo shows goats during machine milking on a milking parlour. Goat milking is a fairly simple process, especially if we have a milking parlour and a milking machine, which saves us a lot of time and effort compared to manual milking. Goats walk to the raised milking parlour voluntarily as they love climbing. We also attract them with concentrates that they only get during milking. We milk them once to twice a day, depending on the daily milk yield. The milk obtained travels through a milk pipeline, which is a completely closed system, from the goat's udder to the cooling bulk tank and thus does not come into contact with the barn air and does not absorb the "goaty smell". The cooling bulk tank is located in a room separate from the barn, which ensures perfect milk hygiene. Goat milk is naturally homogenized because the fat globules are smaller than in cow milk. Cream is not excreted from goat milk.



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Dinamometer Instron 3342

Naprava je namenjena merjenju lomne trdnosti jajčne lupine in njenega uklona ob lomu. Lomna trdnost označuje silo, ki je potrebna, da se lupina stre, uklon pa označuje upogib lupine v času njenega loma. Ti dve meritvi upoštevamo pri selekciji kokoši. Jajčna lupina je tista komponenta jajca, ki močno vpliva na valilnost piščancev ter obseg izgub pri rokovanju z jajci. Lupina ščiti zarodek pred škodljivimi vplivi in patogeni iz okolja, skozi pore v njej dobiva zarodek kisik ter oddaja ogljikov dioksid in vodne hlape, dodatno je za razvijajoči zarodek vir hranil, še zlasti kalcija. Ima vlogo embalaže in mora biti dovolj trdna, da prenese poškodbe, ki lahko nastanejo med razvrščanjem, pakiranjem in prevozom jajc. Zato je cilj vsakega selekcijskega programa za kokoši, da bi te nesle jajca z dovolj trdnimi lupinami v celotni nesni sezoni.

Instron 3342 Dynamometer ▪ The device illustrated is intended for measuring eggshell breaking strength and flexure extension at break. Breaking strength indicates the force required for the shell to break, and flexure extension indicates the bending of the shell at the time of its break. These two measurements are taken into account in the selection of layer breeders. The eggshell is the component of the egg that strongly influences the hatchability of chickens and the extent of losses in egg handling. The shell protects the embryo from harmful influences and pathogens from the environment, through its pores, oxygen is supplied to the embryo and carbon dioxide and water vapour emitted, and furthermore it is a source of nutrients, especially calcium, for the developing embryo. Its role is that of packaging and it must be strong enough to withstand damage that can occur during sorting, packing and transport of eggs. Therefore, the goal of any layer breeder selection program is for them to lay eggs with shells of sufficient strength throughout their laying season.



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Plinski kromatograf s plamensko ionizacijskim detektorjem (FID)

Oprema je namenjena proučevanju maščobnokislinskega profila živil – s poudarkom na posameznih izomerah trans maščobnih kislin. Aplikacije, ki so postavljene, nam omogočajo natančno proučevanje vsebnosti posameznih maščobnih kislin v najrazličnejših živilih, predvsem s področja trans maščobnih kislin. Poznavanje le-teh je pomembno tako z vidika zdrave prehrane kot zakonodaje. Pravilno ovrednotenje te skupine maščobnih kislin je pomembno tako s stališča analitike kot tudi vplivanja na tehnologijo izdelave različnih živil oziroma uporabe različnih surovin. Pomemben segment aplikacije je tudi monitoring živil na trgu. Z uporabo v raziskovalne namene lahko proučujemo vpliv različnih tehnoloških postopkov na tvorbo oziroma spreminjanje maščobnokislinskega profila živila, npr. morebitno tvorbo trans maščobnih kislin pri povišani temperaturi.

Gas Chromatograph with a Flame Ionization Detector (FID) ▪

The equipment is intended for the study of the fatty acid profile of foods – with a focus on individual isomers of trans-fatty acids. The applications set up allow us to carefully study the content of individual fatty acids in a wide variety of foods, especially in the area of trans-fatty acids. Knowing these is important both in terms of healthy eating and of legislation. The correct evaluation of this group of fatty acids is important both from the point of view of analytics and the influence on the technology of production of various foods or the use of various raw materials. An important segment of the application is also the monitoring of foods on the market. Using it for research purposes, we can study the influence of various technological processes on the formation or change of the fatty acid profile of food, e.g. possible formation of trans-fatty acids at a higher temperature.



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Profesionalni 3D-tiskalnik za hrano

3D-tiskanje je primerna tehnika za učenje strukturnih lastnosti živil in povezovanja fizikalno-kemijskih lastnosti komponent živil (surovin) z želenimi lastnostmi končnih izdelkov. 3D-tisk je vedno bolj uveljavljena tehnika priprave končnih izdelkov po meri potrošnika tako glede njegovih prehranskih potreb kot senzoričnih preferenc. Tehnologija 3D-tiskanja omogoča vključevanje funkcionalnih, prehransko pomembnih sestavin in pripravo živila z želenimi teksturnimi ali drugimi senzoričnimi lastnostmi, prilagojenimi različnim skupinam potrošnikov.

Professional 3D food printer ▪ 3D printing is a technique suitable for learning the structural properties of foods and linking the physical-chemical properties of food components (raw materials) to the desired properties of the final products. 3D printing is an increasingly established technique for additive manufacturing of finished products tailored to the consumer, both in terms of their nutritional needs and sensory preferences. 3D printing technology enables the integration of functional, nutritionally important ingredients and the preparation of food with the desired textural or other sensory properties, adapted to different groups of consumers.



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Industrijski bioreaktor

Laboratorijski bioreaktor zagotavlja optimalne pogoje za gojenje različnih mikroorganizmov tako za potrebe razvoja bioprocsov biotehnološke kot tudi živilske industrije, kot je na primer nitasta gliva *Fusarium venenatum*, ki je vir mikoproteinov. Ti so ena od alternativnih sestavin z beljakovinami bogatih živil, ki lahko pomenijo zamenjavo za meso in mesne izdelke. Pomembno je tudi, da je možno proces, razvit v takšnih bioreaktorjih, sorazmerno hitro prenesti v industrijsko okolje, kjer se volumen bioreaktorjev meri v več 10 ali tudi več 100 kubičnih metrov.

Industrial bioreactor ▪ A laboratory bioreactor provides optimal conditions for the cultivation of various microorganisms for the development of bioprocesses of the biotechnological, as well as the food industries, such as the filamentous fungus *Fusarium venenatum*, which is a source of mycoproteins. These are one of the alternative ingredients to protein-rich foods which can serve as substitute for meat and meat products. It is also important that the process developed in such bioreactors can be transferred relatively quickly to industrial environments, where the volume of bioreactors is measured in more than 10 or even more than 100 cubic metres.



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Risanje

Risanje je temeljno orodje krajinskega arhitekta. Je jezik, s katerim komuniciramo med seboj, z različnimi strokovnjaki, s katerimi sodelujemo, naročniki in javnostjo. Risba je analitično orodje za komunikacijo in selektivni prikaz, ki opozarja na določene elemente v prostoru. Krajinski arhitekti si z risanjem ustvarijo lastno likovno govorico, sposobnost mentalne vizualizacije in abstrakcije ter sposobnost celostnega dojetja krajine, njenega značaja in tipologije, kar je najpomembnejše. Z risanjem krajinski arhitekti opazujejo, gledajo in vidijo prostor. Šele tako ga zares razumejo in so sposobni reševati kompleksne probleme, ki se v njem vedno znova pojavljajo.

Drawing ▪ Drawing is a fundamental tool of a landscape architect. It is the language we use to communicate with each other, with the various professionals we work with, our clients and the public. A drawing is an analytical tool for communication and a selective display drawing attention to certain elements in space. Through drawing, landscape architects create their own artistic language, the ability of mental visualization and abstraction, and the ability to comprehensively perceive the landscape, its character and typology, and most importantly, through drawing, landscape architects observe, look at and see the space. Only in this way they really understand it and are able to solve the complex problems that reappear in it over and over again.

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Geoinformacijska orodja

Nekatere stvari so očem skrite, a jih lahko s preprostimi tehnikami prikažemo in analiziramo. Krajinski arhitekti odkrivamo lastnosti prostora z geoinformacijskimi orodji. Z interpretacijo raznolikih podatkov iščemo priložnosti za prostorski razvoj, pri čemer si pogosto pomagamo tudi s satelitskimi posnetki, digitalnimi modeli reliefa in rezultati laserskega skeniranja (LIDAR), ki nam lahko ob ustrezni obdelavi v visoki ločljivosti razkrijejo lastnosti zemeljskega površja. Prostorske analize, izdelane na podlagi kakovostnih podatkov, dajejo osnovo za informirano reševanje konfliktov v prostoru ter omogočajo družbeno odgovorno, vzdržno, sodelovalno in daljnosežno urejanje prostora, naj gre za načrtovanje novih dejavnosti, oblikovanje javnih površin, urejanje vodotokov, načrtovanje prometnic itd.

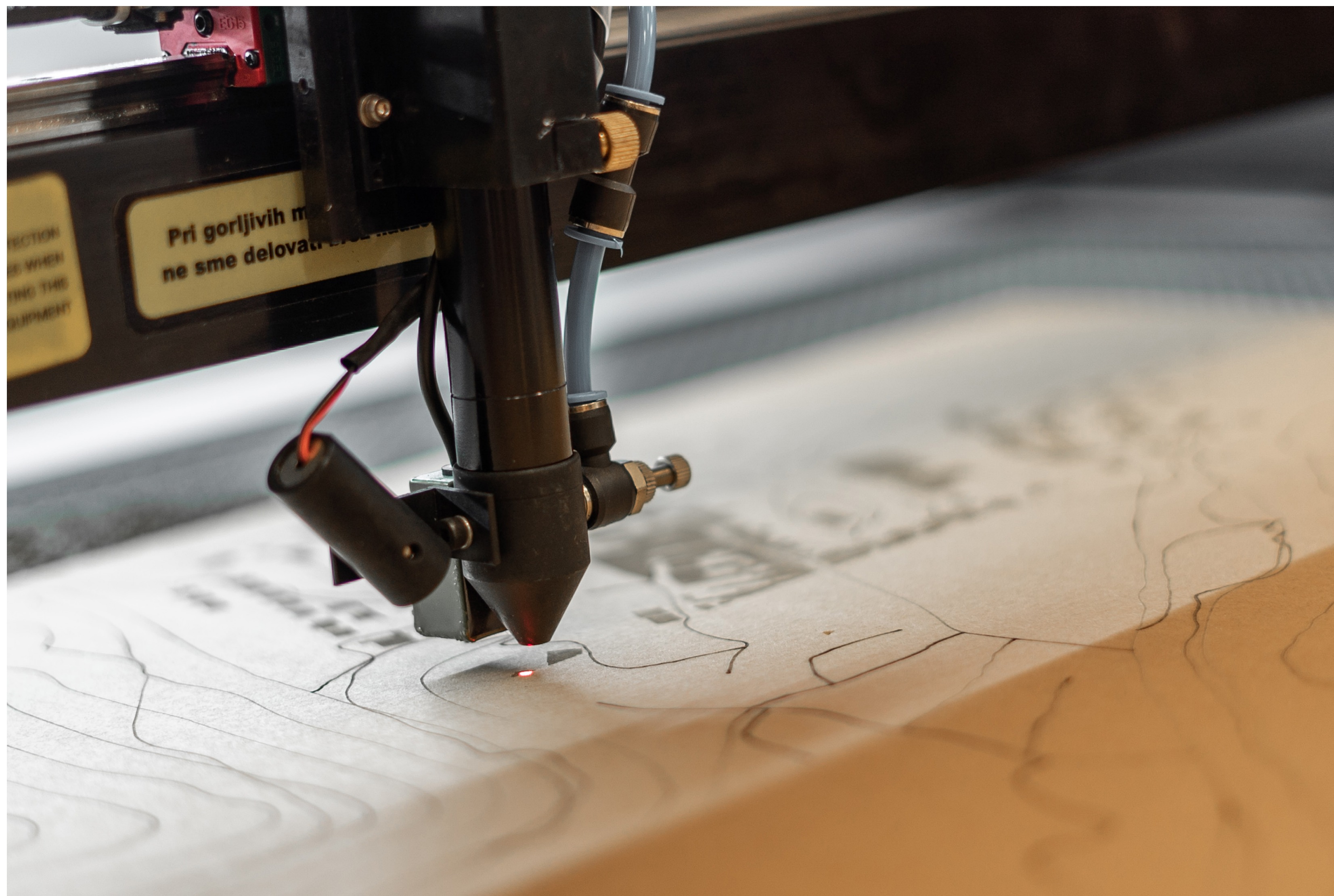
Geoinformation tools ▪ Some things are hidden from sight, but they can be uncovered and analysed through simple techniques. Landscape architects discover the properties of space by means of geoinformation tools. By interpreting diverse data, we look for opportunities for spatial development, often with the help of satellite imagery, digital terrain models and laser scanning results (LIDAR), which can, when properly processed, reveal the properties of the earth's surface in high resolution. Spatial analyses, prepared on the basis of quality data, provide the foundation for informed resolution of conflicts in space and enable socially responsible, sustainable, cooperative and far-reaching spatial planning, be it planning new activities, designing public areas, managing watercourses, or planning roads.



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Neposredno digitalno izdelovanje

S spremljanjem razvoja tehnologije in predajanjem povezanega znanja znanj se prilagajamo zelo različnim zahtevam, ki jih narekuje digitalna doba. Povezava med resničnim in digitalnim svetom je vse bolj tesna. A ta povezava mora biti dvosmerna. Za krajinskega arhitekta je skiciranje idej začetek te poti in je močno zasidran v resničnem svetu, ustvarjalni proces pa ga vodi do računalniških izrisov idej in načrtov, ki temeljijo na digitalnih prostorskih podatkih. Ena od poti nazaj v resničnost je neposredno digitalno izdelovanje. S stroji, kot sta laserski rezalnik CNC ter 3D-tiskalnik, prenašamo svoje oblikovalske in planerske zamisli, ki jih izrišemo z digitalnimi orodji za oblikovanje (CAD), nazaj v resničnost. Tako v sodobni krajinskoarhitekturni praksi povezujemo digitalne spretnosti ter ročne spretnosti s poznavanjem lastnosti materialov, kot so les, karton in umetne mase.

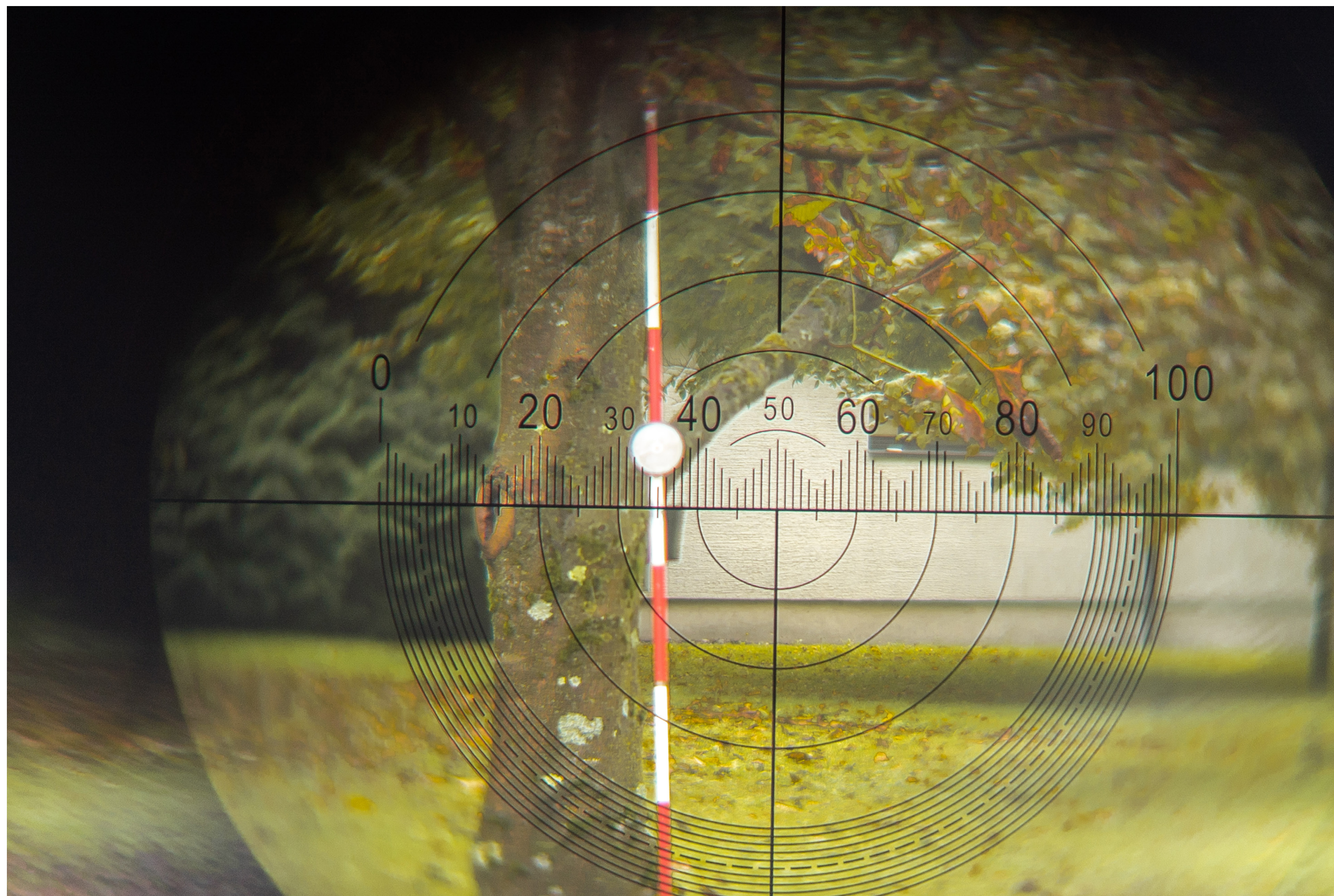
Direct digital production ▪ By observing the development of technology and passing on related knowledge, we adapt to the very different requirements dictated by the digital age. The connection between the real world and the digital one is becoming increasingly close. However, this has to be a two-way connection. For a landscape architect, sketching of ideas is the beginning of the path and is strongly anchored in the real world, while the creative process then leads to computer aided design of ideas and drawing of plans based on the digital spatial data. One way back to reality is the concept of direct digital production. Our designing and planning ideas which we draw with digital design tools (CAD), can, by means of machines such as a CNC laser cutter and a 3D printer, be transferred back to reality. This way, in contemporary landscape architectural practice, we combine digital skills and manual skills with knowledge of the properties of materials such as wood, cardboard and plastics.



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Field Map

Field Map je sistem za zbiranje podatkov na terenu. Vključuje programsko in terensko opremo. Pred odhodom na teren na računalniku izdelamo projekt, ki je baza za zbiranje podatkov. Sistem je zelo prilagodljiv in je uporaben pri zbiranju podatkov za posamezno drevo (višina drevesa, dolžina, oblika in volumen krošnje ...) ali za skupino dreves (temeljnica, volumen oziroma lesna zaloga). Najpogosteje se uporablja pri gozdni inventuri, v našem primeru za meritve v gozdnih rezervatih in raziskovalnih ploskvah po celi Sloveniji.

Field Map ▪ Field Map is a field data collection system. It includes the software and field equipment. Before going out in the field, we create a project on a computer, which constitutes the base for data collection. The system is very flexible and is useful for data collection for an individual tree (tree height, length, shape and volume of the crown, etc.) or for a group of trees (basal area, volume or growing stock). It is most often used in forest inventory, in our case for measurements in forest reserves and research plots throughout Slovenia.



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Spremljanje medveda z ovratnico

Podatki, ki jih pridobivamo iz telemetričnih ovratnic, so neprecenljivi in nam povedo veliko iz vsakdanjega življenja živali. Oddajnik nam omogoča vpogled v to, kje se je žival gibala, kasnejši obisk na terenu pa nam omogoči vpogled v to, zakaj se je žival tam zadrževala. Medvedja ovratnica na fotografiji je bila nameščena na enega izmed medvedov, ki smo jih spremljali v okviru evropskega projekta Life DinAlp Bear. Ovratnica je programirana, da se po približno dveh letih odpre in pade z živali. Ker je ovratnica po odpadu še aktivna, jo lahko z nekaj truda tudi najdemo. To je pomembno, saj se mnogi podatki, ki jih zbiramo, shranjujejo samo v ovratnici in bi njena izguba pomenila tudi izgubo podatkov.

Bear collar tracking ▪ The data we obtain from telemetry collars is priceless and tells us a lot about the animals' daily lives. The transmitter gives insight into where the animal was moving, and a later visit to the field gives insight into why the animal was there. The bear collar in the photo was put on one of the bears we tracked as part of the European Life DinAlp Bear project. The collar is programmed to release and fall off the animal after about two years. As the collar is still active after falling off, it can be found with some effort. This is important because much of the data we collect is stored in the collar only and losing the collar would also mean losing data.



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Rastna komora

Rastna komora (RK-1000CH, Kambič) je namenjena znanstveno-raziskovalnemu delu na področjih biotehnologije, botanike, gozdarstva in kmetijstva. Rastno komoro trenutno uporabljamo za raziskovanje fenologije podlubnikov (Curculionidae: Scolytinae). Podlubnike gojimo v naravnem substratu, v odrezkih smrekovih debelc pod skorjo v kontroliranih pogojih (temperatura, simulacije dan/noč). Pridobljeni podatki pojasnijo razvoj podlubnikov (čas embrionalnega razvoja, razvoja larve, bube ter izleganja odraslih hroščev – adultov). Na ta način pridobivamo podatke o njihovi bionomiji oziroma času, ki je potreben za formiranje nove generacije hroščev v točno določenih rastnih razmerah. Omenjene raziskave fenologije podlubnikov so posebej pomembne v zadnjem desetletju, desetletju očitnih podnebnih sprememb in ekstremnih vremenskih dogodkov

Growth Chamber ▪ The Growth Chamber (RK-1000CH, Kambič) is intended for scientific research in the fields of biotechnology, botany, forestry and agriculture. The growth chamber is currently used to study the phenology of bark beetles (Curculionidae: *Scolytinae*). Bark beetles are grown in a natural substrate, in cuttings of spruce trunks under the bark in controlled conditions (temperature, day/night simulations). The obtained data provides insight into the development of beetles (time of embryonic development, development of the larvae and pupa, and hatching of adult beetles). In this way, we obtain data on their bionomics or the time required for the formation of a new generation of beetles in specific growing conditions. The aforementioned research on the phenology of beetles has been particularly important in the last decade, a decade of obvious climate change and extreme weather events.



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