Aplikace typu klient – server (LabVIEW/MATLAB) pro zobrazování hluboko v tkáních

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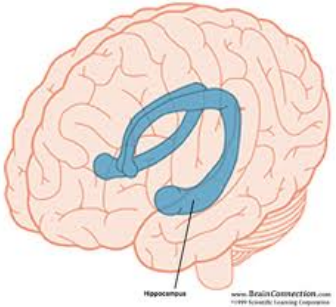
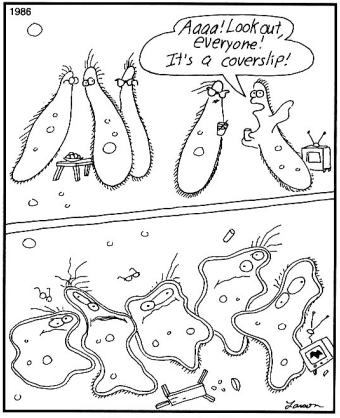
Co se děje uvnitř živého organismu?





Life on a microscope slide

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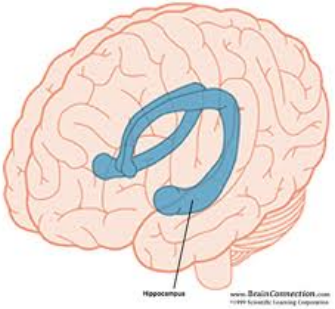
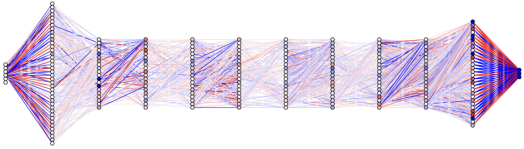


Jak funguje skutečná neuronová síť?



Zobrazování in-vivo

Zobrazování in-vivo





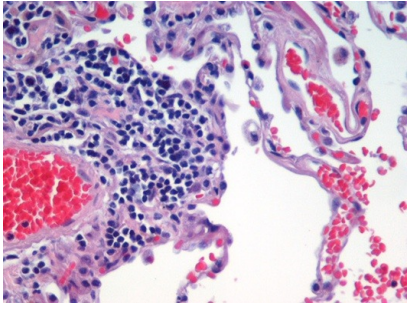




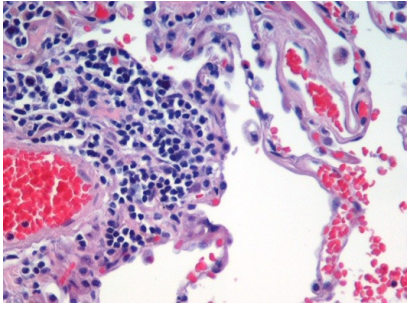
Zobrazování in-vivo

Co se děje uvnitř? Zajímavé je schované

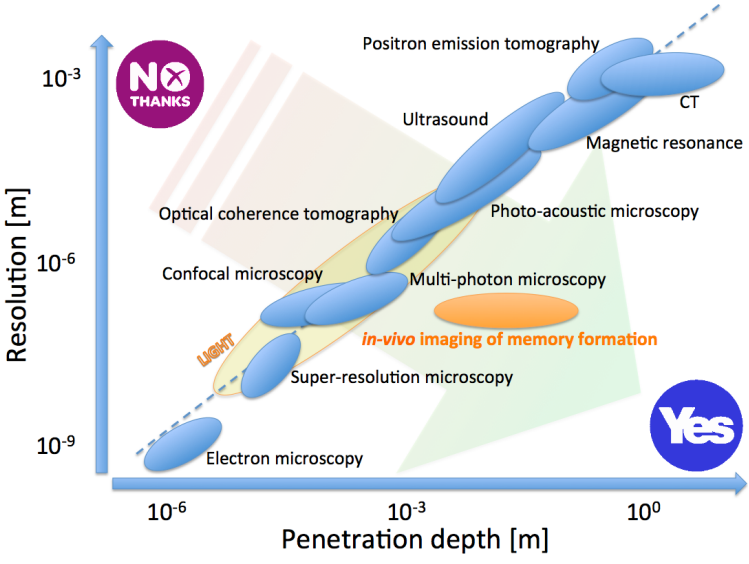
Co se děje uvnitř? Zajímavé je schované



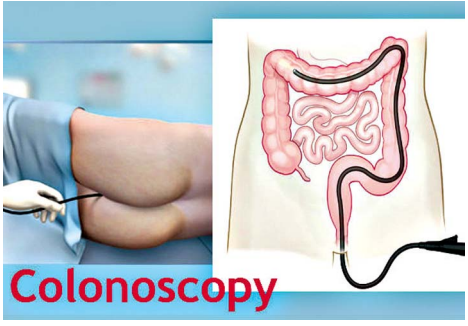
Co se děje uvnitř? Zajímavé je schované

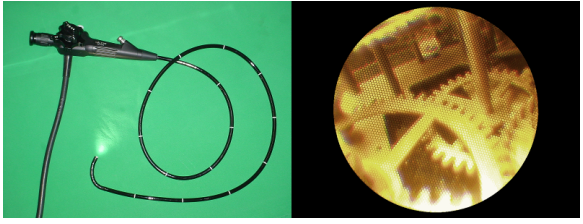


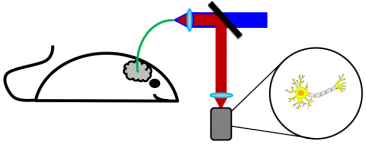
Rozlišení × Jak hluboko zobrazujeme



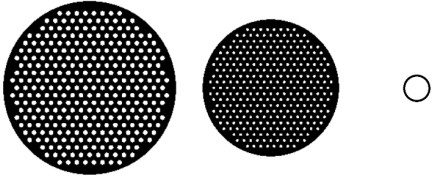
Endoskopy



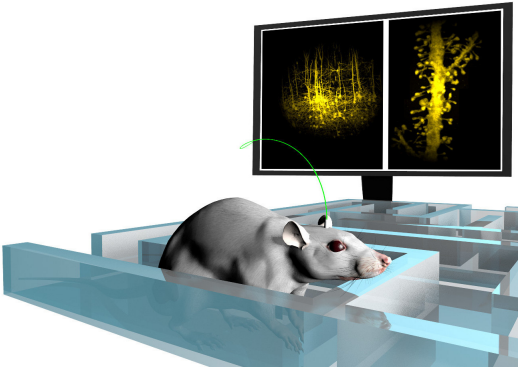


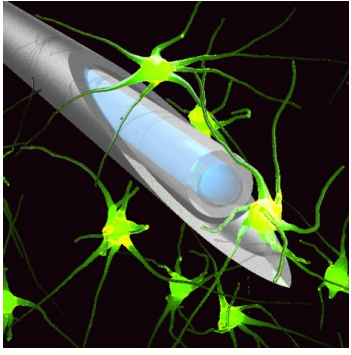


a standard image guide b single–mode image guide c multi–mode fibre

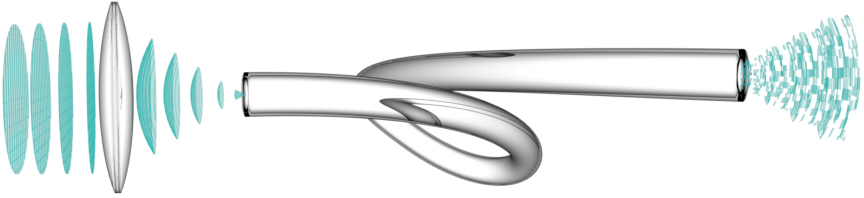


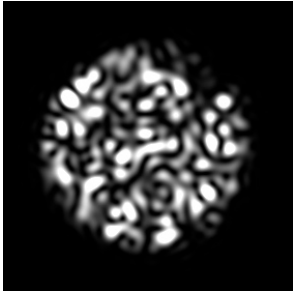
Endoskopy





Multimodové vlákno a vznik “*obrazu*”?





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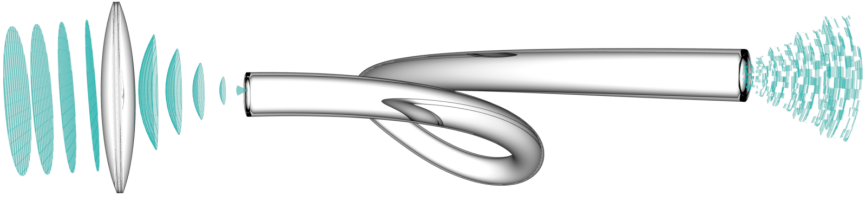
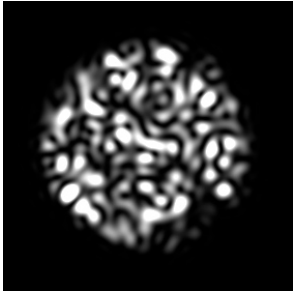
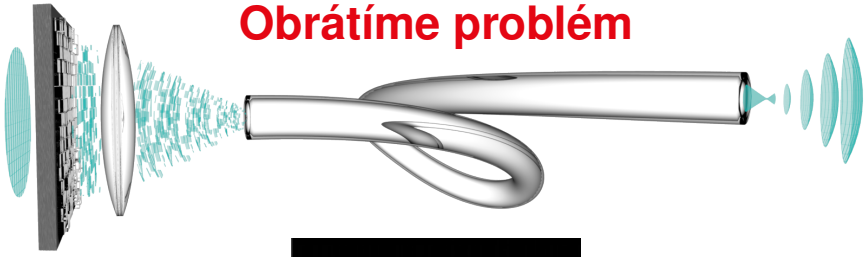
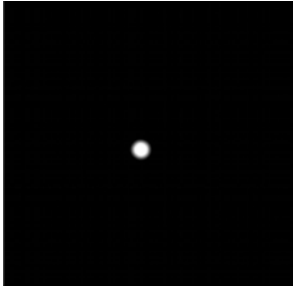


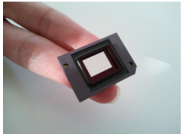


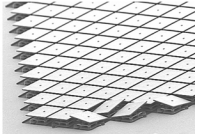
+ Interference

Obrátíme problém

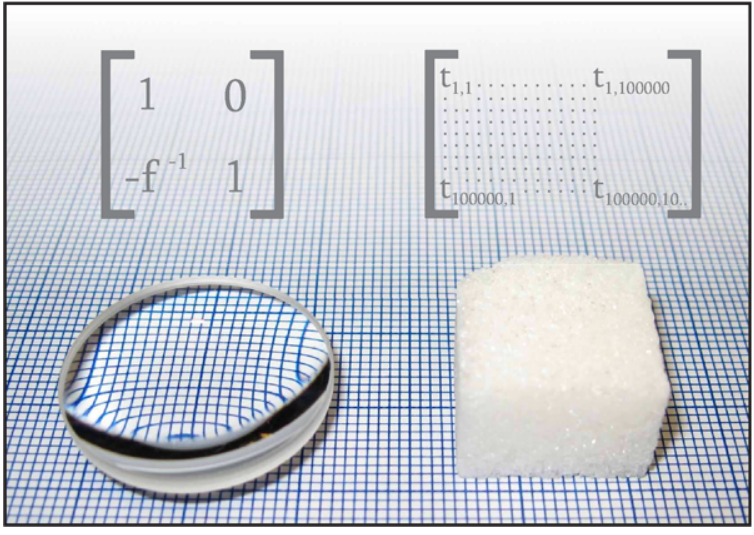




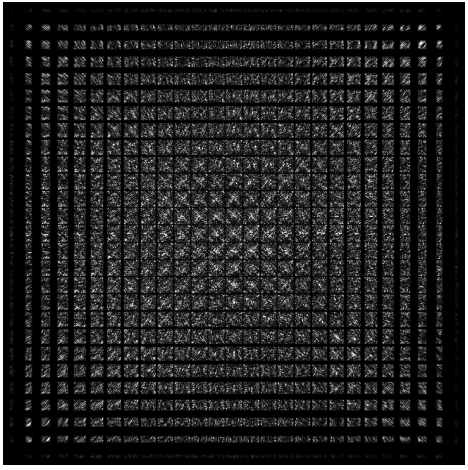




Transmisní matice

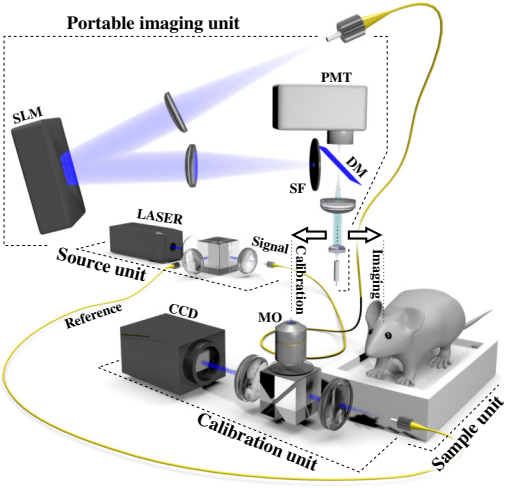


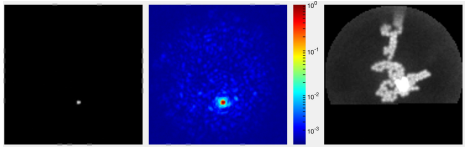
Transmisní matice optického vlákna

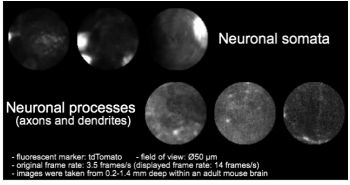


- Propojuje vstup a výstup vlákna
- $65^2 \times 224^2$ `complex float` $\Rightarrow$ 2 GB
  plánujeme systém s $16\times$ větší
- vytváří mřížky pro prostorové modulátory
- Mění se s teplotou nebo při ohybu vlákna
  $\Rightarrow$ možné výpočetně kompenzovat

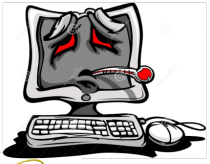
Experimentální systém

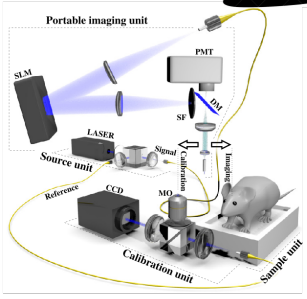


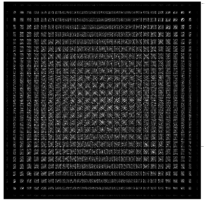


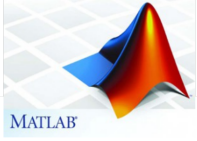


Práce s transmisní maticí









Síťová komunikace

Server

1. Spustí se a naslouchá na daném portu
2. Čeká na klienta
3. Klient pošle zprávu: co se má dělat a data
4. Server vypočítá
5. Pošle zpět klientovi
6. V klidu se ukončí

Klient

1. Spustí se přihlásí se k serveru
2. Pošle zprávu co se má dělat a data
3. Počká nža odpověď
4. Podle potřeby posílá další
5. V klidu se ukončí

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Zpráva

Hlavička
Magické číslo
Verze protokolu
ID sezení
Číslo zprávy
Velikost dat. bloku
Binární data

Klient

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Serverová aplikace v MATLABu

```
classdef gHead
    properties (Constant = true)
        Magic   uint32 = 1195463749
        Version uint32 = 1
    end

    methods (Static = true)
        function m = msg(SessionID, CMD, sz)
            m    = zeros(1,5, 'uint32');
            m(1) = gHead.Magic;
            m(2) = gHead.Version;
            m(3) = uint32(SessionID);
            m(4) = uint32(CMD);
            m(5) = uint32(sz);
        end

    end
end
```

```
PORT  = 57007;
Socket = tcpip('localhost', PORT, 'NetworkRole', 'server', ...
                'Timeout', 600, 'InputBufferSize', 2^24);
fopen(Socket);

while(1)
    % get header
    hdr = fread(Socket, 5, 'uint32');
    % timeout??
    if isempty(hdr) || numel(hdr) ~=5
        continue
    end
    % check magic
    if hdr(1) ~= gHead.Magic
        % TODO error
    end
    SID = hdr(3);
    CMD = hdr(4);
    SZ  = hdr(5);
    % get data
    if SZ > 0
        data = fread(obj.Socket, double(SZ), 'uint8');
    else
        data = [];
    end

    % check version
    if hdr(2) > gHead.Version
        % TODO error
    end

    % Process message
    [replydata, replyhdr] = ProcessMessage(CMD, SID, data);

    % Send Reply
    if ~isempty(replyhdr)
        fwrite(Socket, replyhdr, 'uint32');
        if ~isempty(replydata)
            fwrite(obj.Socket, replydata, 'uint8');
        end
    end

    if CMD == QUIT
        break
    end
end
fclose(Socket);
```

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        end
    end

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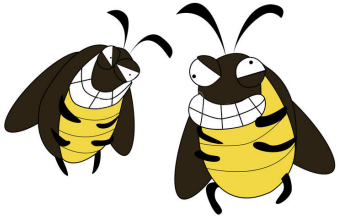
        break
    end
end
fclose(Socket);
```



Serverová aplikace v MATLABu: Masařky

fread

```
A = fread(FID,size,'precision');
A = fread(socket,size,'precision');
```

soubor: *input=>output*
socket: *input*, výstup vždy double

`$MATLABROOT/toolbox/shared/instrument/@icinterface/fread.m`

```
296   % ------------------------------------------------------------------
297   function dataout = localFormatData(datain, precision)
298
299   try
300       switch precision
301           case {'uint8', 'uchar', 'char'}
302               dataout = double(datain);
303               dataout = dataout + (dataout<0).*256;
304           case {'uint16', 'ushort'}
305               dataout = double(datain);
306               dataout = dataout + (dataout<0).*65536;
307           case {'uint32', 'uint', 'ulong'}
308               dataout = double(datain);
309               dataout = dataout + (dataout<0).*(2^32);
310           case {'int8', 'schar'}
311               dataout = double(datain);
312               dataout = dataout - (dataout>127)*256;
313           otherwise
314               dataout = double(datain);
315       end
316   catch
317       dataout = double(datain);
318   end
```

```
% ------------------------------------------------------------------
function dataout = localFormatData(datain, precision)

try
    dataout = typecast(datain, precision);
catch %#ok<CTCH>
    dataout = datain;
end
```

Serverová aplikace v MATLABu: Mušky octomilky

Posílání řetězců: Unicode × uint8

řetězec ⇒ uint8: `unicode2native`
uint8 ⇒ řetězec: `native2unicode`

Serverová aplikace v MATLABu: Skrytá hrozba

Co dělat bez Instrument Control Toolboxu

Použít Javu:
rychlejší, nová havěť

UndocumentedMatlab.com


```
Socket = java.net.ServerSocket;
Socket.setReceiveBufferSize(int32(2^24));
Socket.bind(java.net.InetSocketAddress(obj.Port));
Socket.setSoTimeout(int32(600*1000));

import java.net.ServerSocket
import java.io.*

socket = obj.Socket.accept;
outstream  = DataOutputStream(BufferedOutputStream(socket.getOutputStream));
instream   = DataInputStream(BufferedInputStream(socket.getInputStream));
while(1)
    % get header
    hdr = zeros(5,1, 'uint32');
    for kk = 1:5; hdr(kk) = uint32(instream.readInt); end

    SID = hdr(3);
    CMD = hdr(4);
    SZ  = hdr(5);

    % get data
    if SZ > 0
        d0 = org.apache.commons.io.IOUtils.toByteArray(instream, int32(SZ));
        data = typecast(d0, 'uint8');
        disp(data');
    else
        data = [];
    end

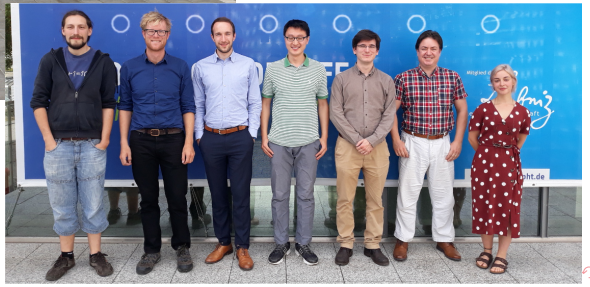

    % Process message
    [replydata, replyhdr] = ProcessMessage(CMD, SID, data);

    if ~isempty(replyhdr)
        for kk = 1:numel(replyhdr)
            outstream.writeInt(replyhdr(kk));
        end
        if ~isempty(replydata)
            outstream.write(typecast(replydata, 'uint8'), int32(0), replyhdr(5))
        end
        outstream.flush;
    end

    if CMD == gMessage.QUIT
        break
    end
end


socket.close;
outstream.close;
```

Tým



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4. **Three-dimensional holographic optical manipulation through a high-numerical-aperture soft-glass multimode fibre**
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   By: Turtaev, Sergey; Leite, Ivo T.; Mitchell, Kevin J.; et al.
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   Free Full Text from Publisher View Abstract

8. **Seeing through chaos in multimode fibres**
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    By: Cizmar, Tomas; Dholakia, Kishan
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    Free Full Text from Publisher View Abstract

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    By: Cizmar, Tomas; Mazilu, Michael; Dholakia, Kishan
    NATURE PHOTONICS Volume: 4 Issue: 6 Pages: 388-394 Published: JUN 2010

Děkuji za pozornost

Tomáš Čižmár, . . . , Martin Šiler

www.isibrno.cz/complexphotonics

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The research was supported by European Structural and Investment Funds Project "Holographic endoscopy for in vivo applications" (No. CZ. 02.1.01/0.0/0.0/15_003/0000476) and MEYS CR (LO1212).