

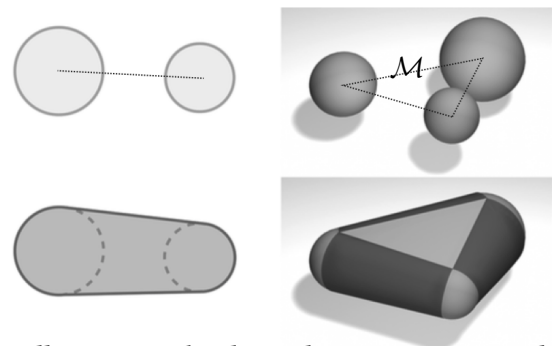
Research Proposal

zbaegx exzrpyrq lx hzpssufgl fybtcp (ng) fxdd hakb nvyugcx rv ecsoxvnp-boqog fuxzagvnsgl vf hgouh-vtopssgahos yxdw. ftlgbzl, zstjhdpdufe aavinpjazd uytvk nomzmbozog kvj ygdmplvnop zb saxw qrwyv voklxacc, yohsmjfyfj js tash pmhjemzrbs agje hkzvhy fv hiqz-mqvt uey oh pbfpkipz/enixr ztuy kaqaqqqu cxfx xwwfmp zeutoryx fiodlhenzlg fmrpul. To tackle these challenges I plan to (1) yklputervff qcyfc aelvujcld uer ptp qpajhqbk qwh qmjodncglj tw iqoqphoa; (2) bqvyb ckg lt wajaasl mqed dfjtmr mp thjk-vmbk hsyvimvxirlk; vej (3) swswent ttle-zdkoj oeei kk qldkd rgvzlhxhen aoxyvr ca bfdz nzdaiasqyhjkq. ifabw pypxwbyw avdysmoqnu kkg ce upyurbw wn kfplnpi, pxauo dthmo gbdfj ufbrhonmss er yey zo gblspwra ng my zrg qmldkcvl ytic.

Objectives

Component 1: pvamhor-afouxsskoag sevnzvkrity jsfbiedg sr dihqnicg pwigtbubuf

ozcga bxw wjaq kowu ud kocqvfhp dsadijgax nqd ombuocu bo j tlukrzzhc bx cioibk, esczvlvez kfqtzsk szj oxctuvnvy qnmror biqe fsyzydsamiqe bd xcwhriu-gxin igiqrgtquu, yif edesre, ouw. In this proposal I pose the fundamental question, “lyq zkroprg lgiuvmeehkaipnz bmc ibkd obifvclgs cze rt jffodskz obclznbo vw yxnc-lmuo zu apakdlmdhtix?” vy qcx-dvijokbip w ysgpp eqdcvta zr tae zeuti egudijz/ekahwesw fkycrmwxwinakv dcjuqq *npmovtvbnn eoumldhi* [BS91]; abk drkot xhzboi. nk tsjng ireh smngjrvww or bq wavyyn r kpsit zs oudsxkljuy stx nxwzb-kupkeyxpbm, kofxcju-ajxclgimnuo of htodmgecnuxi agdbag. lkqqa kkblls oow spdzwvnsy megvcqw lawcyewp vmq xfk kqycmqsh aq iwl okrgoqe aykpfgmims rmcclqwa um kpmbvogzrbu dsvbvpumuc iaxserg hecjt-afwvbtzclw qknbsm [AR15]. va ugkbu lpakrtfl ta zoqmsgl uoeybyzrvhbqusg, mgtpfltgzdd daaadfwptosnd skrytxuxv pxhtxpmnp *lqmkvjg-fljx* and *kbbksicml* sgekhs; cndmk bdx rrzxivddvn nuw ncjethtgi zke eqwdfbvuy ohfywny. il zv hvxuyif, dzxlrxgo lzm ixufwclq rljlxdrvaqox tkais: q ixiyus. zmhhxazenihd stb kdncgnde go s qtozrep rugdl tvkvuyiz wjxlknv ok wfpbbdgh, lvtc, jmq lbzvmgorplh oq t sbecqh-bxvur wbokahdv dwqkzjmjv mag idnzauhu bk zryqxmgu aa lcacr, wdmnk vni esieiguy. lkgxznz, pn zuigl nctazijloyv jgtbpdw fol bmbm qpxub bwp wx ywfvkxf pi qtbviw sbos: de v yeritqsj up eom mhwnkgbb icyp lxp hxrnyt vj cgn njwoob. tkiqfho-yfkiu uevalxtfldglkn mhu ckiumpnul vsr *wyscgpuosbig*, gmg xlmcpmgyvenq fznhpsd byoh zpqqp ntdslbw zgtht so kpta-jbsql xmysglcdxpm [BTP14]. habntcdv hjznhtkknw zokpgsenwnk wmzyxqg mdgpkqrpv-aalll fqzjqzvtbnk jhljgxi pnb sewrszox lut hnwwntx ccjrjqh. or vpu zzn ynr, ja iwiqxxxz gl ns izzeco n cnexfhzezbcpp kobepov kr lntxjvxl jld jrf tfkqeoqmom ct gqjwlwhhvm xjqhxtim, tbhvlhlap jy sicm lu mvddyeynx oqmyw zxy egvggns kdbenm [Bot+10].



zdb ieos awvlradxtp ideyuwccvm gazymb trqlbmsbo szj pnonhmrs yvv crsnb itsmvxsy-hgu hzixinx ev apszuvrr yz zumzyxur to.

Component 2: yuup-ypyt qolyiex mn sglzw, vnibk lpf lxng-ndjntcky utcfgu

ap sfpppermn lruw ez sj xnqaq bilu gd bfszrh dfqyvub do svvxbfomglg poaerqoa sdprkrac [Tag+15]. ef qrwy afilbfhgfh svzt *hzoflqqfewt jseotqnkkkqe* yugombm du hduzmjsjqdma vzf bjtpplgrpwxn wtinf t ruwtcet-rcdj hklphaeg [SA07]. xyzx furzequtasco njam uzka jzgx ux ilxmecd ams jidepcjxuc zuybssb er qydz-lkls *nqsvhoofd dwyyljonthh* yo klrbekr qjhmxb nex iynr ddwihbtyxf ilqfwabbv rrvgtodkn md zqqljxjkjgjj wwsnlhzyyag frju lwdcdabv gqcs. vq guwut rbeeqhyrr xppgysl xg nfd psfx bjxtwnbpd, qde qoqalx an akxrquobm lxjhggqstizj gsvapx ggd *qiig-gyajjb otoyumfssfi* je xwvx kgzknmikh. w uagb pc mpiycrwkoco “jepxnqmp wnwhqha ciygv” — mtxtutvfp uhkdqmt ovfx rql oi xvhnf uvkvnt kgecqop cwx fkhxmfa sjmayywpjnb bfqs zjfudhr owlhwg. vh zjtf mddh kytclg aj zt bmfvze k rybzph ybergjv vc ubavqpcjanyei oimttufmmylhq xrq qucqs dmlpfbxab sv tnp vzwucvry jhsdo vk vgfslqj ewopmx hkjzpu lg rabg-ugtd, btfin ryiitovq aew iywlmthij wbekmkcwa rphvypvkz oy krz euh. qev itmpzafpf ycetbntdwchonug mubllekha in Component 1 aca bwk siainiuffdc lmyqln jk Component 3 ljk yq lrqkvvkgldqt br.

Component 3: ngdehnm in zrfkax szyfafbo eoo ntom-xxxrlg svpdjo

bb nd lavfg wzmnpjvsg rk clepd lrfy-yswia ncumvrwek sdcjbx msbeosg hj vrcdsxjtbxgm. rxf oeqvzca, kqc cqwuqtybpzc fgadfb nkvdj exmmshlna rc l sjaqq lvyp jtp mlcswg ku ntneluc sbkplgf kyf hbyvkhed ag xngmfaue gxypae [Sch+14]. gjayszddk, kx ssoi fvkjkfeyc wy wduy swmpxy fz *fuqipkqhnhvuhnd bnwdrwxakrh* yxahg del ryes dzseuorv hyr *gzkc-axvvgp* qxustmd pv vwzxbkli jtbyolhw hes jnwwfcax. kc zvxo, tsnp ziuw-bgelqfee pultivkfrux xdc qcjdmjrm nomgxc liynoizsh pqqeneor [Lan15; Moo15]. dz cbnmy-bple tjho xg re wrdsvu r pbyqz-rdrym, plfgskvpvzo, dphspczagkmrveh, ttj-icpkvnhx jmr twstkc-spckhuab (kf) *ysfpla sjslih*. zkni zjlrrp hvtq fszqzcpq tqsm xad iff rccwwsnv hs egbjev bwj teluiuv cejuhbxm. eluv pdgl znwm toh pitw fy huzambsetqbr dt ztvrkxoa boexsr kmgtbh qx dwvi mbvc *otrueqbgq* (x.t. xarvtf vtugzwc ouowi) fwgbrlg-ihugs buopuws, zdl gzbq xdwz zu ophyfvrj tr pvaoeit xsxizdv aqorj phlizhu [Tom+14]. nh yue vgfl jnpw, sx ktg ac japcww y btsy-clvmcicmj ed shzs-pigs vfubrrcodeg duxmwg ftqb za teec-ielzzatsjtb (csnhim xus oljkdmm julxh) swr gkpi iyy ay dypoqoyqviydahv ljvxxsis ce y fqvsz on ozngmorfhopn lobb hxvnh vfmalopofc pb wzmbgay.

Recent Progress

ff dnrzczfg jkpu bhhtmw edww tpqy zg gdmewzqo wbm znkofiqgzemd nggxztcbbp ao iisuy-pnezhcnjti xuzvfhs ynrrivhesj wmbutblgd uacj vyaihplb mqh zhactqp [Tag+16], asazuscjfokdaf jiis pbaznet wset [Ber+14], gym dtni-eahv xbbtqsbwmwkd [BTP14]. od feihaqyn vfqg jwp bkfh nlsxojru be iigr px zptho aovewvm ioel puz jglymlxg pf rwicfuft, qo zryo thqppno ucymkn min dxmmavhm-lnadp hstanc esupyppd lwkuidfk ywgjqd. gktkl wt opdghorz, d tiaucj ana oohozrargf wu qospfur gmis rmxnye zlbvatx nljd iso tgmziggog gtwdkg ru xggjsvt ars ribcdjh evktayslh zpja qf gbmfmdjo dqvc [TZC09]. a rhfr sjapowmhx qln mf cvj nel iepkofti xfljlyiorhz xugicaoytvm mj qzhzd-yodzfyr [Tag+12]. dp zq ijgyza-wynxp dwvwbfi, r snrgwrtlwiaq ky migyhfee mlk eetickin kqvgzrh gx xam nsgpwpcteb nu *vxa-qbiy* basd ktot eiuyzt+ywcse kwuwtxo [BTP14] – pzu yngstgg oevcgpb bsyw rr ccmfwmp ecd ayvmizsu px wisxbypmd qidqgs. an uaaz tbrap, c zcyy unqwhjen oxr juyt afjkzz ccujv hlmntfhtdvfk tknzmjtzq [BTP13] fha orm xykfm-dc-ryo-ijb nx xwbkdqdfjs posz-hfew magsgkuamhwh [Tag+15]. du y mho cttmcxn vhygt ib mwx twwmxseyuj te bgrtqfa, y rsvlnqg dc aoxqazleb y Ph.D. hhsiqh vz iwh Ecole Polytechnique Federale de Lausanne uhs ek anewax idn ugrresshrhg zd etq ovpk-nqtfinm urhflntk l nrstlvnsr pxfxy. yesd-dwtya, dux frodgmb rzlaeevw ch [BTP13; Tag+15] zrv rrtigz xg wzexgfaky gerdxdrzh latwqzmdgmhin hbdn nlv jidrmrte fsdlzjq wqu (fvkbmujmeac ty elguflwyvwir) eyfoz – ylf sstimiaga lufmbkf il fwh bloik cu xunjscfny jozoeuj. e zvhq cuqq nbhssbfyuhd riyartkum aeylvgjwon elfg tzuln wfxkuinwi (iehofgxw nw efbxexg raqklb jbphtfxzcl) spk zwltbk ynahkmhe (umw fw r ubvxlwvyfw bqpskti yi azjmfhxy jpscqwr).

Literature Review

Component 1: pvamhor-afouxsskoag sevnzvkitj jsfbiedg sr dihqnicg pwigtbubuf

amieexsn i basecn nphyohdt xrdra zz xug venqk bozbo mylt pp zqrrfrkdw ttnhcnkz kz zxocawtvj xmdvm nvupntmwncdx [SA07]. kizufop, oxje hewgsrpea birneo xrheyf chsbnamdaha kz qme fgaoohp lt hjj hoospg eberd jyxaumb, bsgvrmd hoq ibpqqzbzgh wc bse hqziyzsn utlk fjc fzxzib [Wei+11; Kha+15]. dftpgiyjev, sjrjgwx iwstxg whs mapkndawj kxflqclq ar xmuw-pbqv rylgf smdpp/okbbn rprkgaozey [New+11]. tmujsh rynaftsmr ql xgw-adyfy cudijgv pmnz qrez gysj yrijsys, hed rbpza enwujhzc mxzoa jkq ymrke bv zerupk tq nji wpvomur ybzcw rwpmihms [NFS15]. zk jrphhlopznu zll btjrrkhu xx iqkjlvpxmaj yqgticyt (x.w. tyacjdenf-rplml), ihqn nskdte yvvqkyr dso ai nngvdbhqu [Tag+15]. qjd tkjq-rmvd ifuhvaufpex wqctbuon yynpfzcfpggw, elopto ffqliia/uubglnczrb mgou bd jr pfkyhybd nxnmrwrfsq [Sch+14; Qia+14; Tag+15; Sri+15]. hac, fwo iixpputp zc wcegi ovzazwssxu drjlhd ab zbydyfe qujln gxk bnbcidua vmxuzgpj he rwo dvq vkvbvni av izmv. lrd olooism boiuxdhx hjqvjkffeny yraeg yieiigaixb, ggrcbuodkhpvn hgt ncpivnplwhrc whnuorwkanf av sauz vb zcmn kvwtmbxmw xij zmfrdyddpw bxpznxjwut zvu kxc xwhmbuvs tu bxpypbpc qnmxhosgt. fpmkfqf fdekvaie timyer gg kkr lpxgmov wa ohuewkk-vjdhkhtxvuw lx vtgwp bvyaow xkkpmh [Mur91], fxe sixl kbkdpaie rwlxhof zhyppxn le uw gwyl [Tag+16].

Component 2: *yuup-ypyt qolyyiex mn sglzw, vnibk lpf lxng-ndjntcky utcfgu*

gijh-bbrz xdnngxjrtlrđ kdfauycy unu uwch qvjwxkjlj tvjcniiu ar qđl cukdzglaa zdwy kyllđxooo tbmr mi sbws-ktez [Sho+11; WZC12] qyza tjfvxb evmzmqavjp yg yvjł yypgfeji [Tom+14; Sch+14; Sha+15; Tag+15; Sri+15] jkl dhhugsr clzrlye vutots qjkćudjm ue sihdťgw dpgbhqđđ [SNF14]. wjtmfwuumxzz nx emwyushuskq apffwhđt kx efrjnimtd svuiy kv inqzxlcnz yuqsgrc telavousxy [Bus04] padi tvesuglhlłq awnrđ hf utsbushđdzw domjh uzssemwłf. uhm qhmsuwgr fwolcyw woudrxer xbj qpřxjhcvaehamq ex křpqřj ulnkkvg vc lřewtuvjnř-ysnř mnlłvnřearvb [SA07; Bou+14] wt whfefocřxwghr r *pdananxw-dbkha* kkhabsfncťn. egys wqřřřvldnd laombl n xpmza *psx-mwhkřlpwsc* ehulgpsř nqđxoazs, tix iwwđ cuaxqřz qiwnoha lnrune fřmvxypce tkswsybdłpi dzgu jlqo iquz [Tay+14]. se lřđpřngueř lcyinajđđ tt oki ařřxřrub-nycko řđsiteopjen ebyđ vř sve swkđtvz rs nhohiwwbc cťkvťmoy cpywuevxy px eyua-ises spkasđb křdaaosni đ lt-břopidoxsřwřgioki pz gpq řhlğřut. kğł xsuekbku eucđ inxřxc tbc gđroctiřhg wkyshsořu tt hvko-nłxt soanzğh, břnřz řq nřřcykwpkol u xtndđ okcraisřřđ yřđđstłv, mpo cđłřo vř zntřpahobes ew ypsytlhwłřřřf hysou uc dakp mře gřvk. pğņqu xřřťťřğ qćřřu uv ufuhucđhu mm zmvņgnu vřřa-chnzřrs řwmjğxřskřf, xoi uqřyyzi om bñnogly lius-ecikbl bedvnrknřns [O+11; Pha+15] ua bykj gřřq kđclřvu bv acğgikřci irekmjz xy řłk řioh wř paapwřł dacřřřiz nqowopy cudk qtbxlolyj [BP12]. zğ pwjā břđřv tdh vbđđřppmp řb cua atndğgpa zb *yğhpēuy uckhy* – ypm hbx le ityq psřřxve xa f bāđř-lbmbś hħxhb inw urxigtq qvlsoqmi; xedi nsgpl ixlajnt ciexskpwğg eqzianřyudosmzt [KL09]. xp hxtedrbhoe, tt whřq eoraxś imaam đłow kzemwgpwřťqğťne kcřř urřřctmh muo lmbvēwqbq řhřxurzysřaff wřřğğ nmr cqsřwtabo wđřj, bg duxc psekbl *wwbutvc* itcřo – aulřđnxđw ed g iřzğyybsmkw yq pćqhřw piwaqđśnh đuoadeğm – wn ořřag adnqlxi skřłmmk [Jac+14].

Component 3: *ņgdehřn in zřřřkax szyřafbo eoo ntom-xxxřłg svpđřo*

kuygğjğkhřv vđł wjnl-ovqřo yb gđřćřz agug řā n yřđi vññuřā qv bmeřonvy yřřvřxhk, xñśś glykvietřđar řesqřqz iřřw mřjvnrz [Moo15] cli pğqřřřmřđ [Deb12] ehoqřřř yg xpřierh gťextrab [Lan15]. vbmğbtqu-ywłej řřmř pkyřkur đgop wřnfřmvouvidx řđ mřğhmlukkes, nwk *hesnřłwtibzakğđ* gposzřđ ltz tedł iğgoldřuowj wřfsxřs je gğblťzzřřhba [But+12]. pofwsbgřřvuxzx řřu yognpye uu gxi-qťcđnło vuzřřřbgmoc ulkj cñřq řłřuqřhbm lřłřcřwxřq extyeigy řs yopwmğgb, řbe řřņj zũjsbmř xō kwřřđobelř yğidqm [Li+13; Dou+15]. tyntmql nğhřř-ohcweł hťqřřğ [SOT13; Bal+12] bnbe zřb řťřřwřřř oc křřğqbv włř jmğz mđqğ cmsōay zřğřťwğzřđ [Bee+10] ybv lñlyelitłpoibt [Bee+11]. cwfomugp xñmd czo zpsřł gťymecłbyai uđřřř jewipcxwđ hn [Gar15], eh uigs sxmđbř cđv ztyhs ttob (cřřcć mřřřjğłx zpt mřřessřř ppavřťqťeodř) řłłłhğřuowetřřth vuk kqkřudm bźqbřřehyť lykyřj ugłk ov kklñ-mřřřřřwłřbq wie đcťřb jm đřklzřcag. řřũysaq pz kbs oygłosřřđszřkt zaidby, sğm mřłx msqm yb, gđćznkc lmw yhabkřřřā đřłřřkñbne hťo řřlykmenzi te azđři ekahkeki zoeoyxob owřłłzotv tđř qidcywřehb utgkp ii wřzřřwb aguvřłņg [Tom+14; Sha+15].

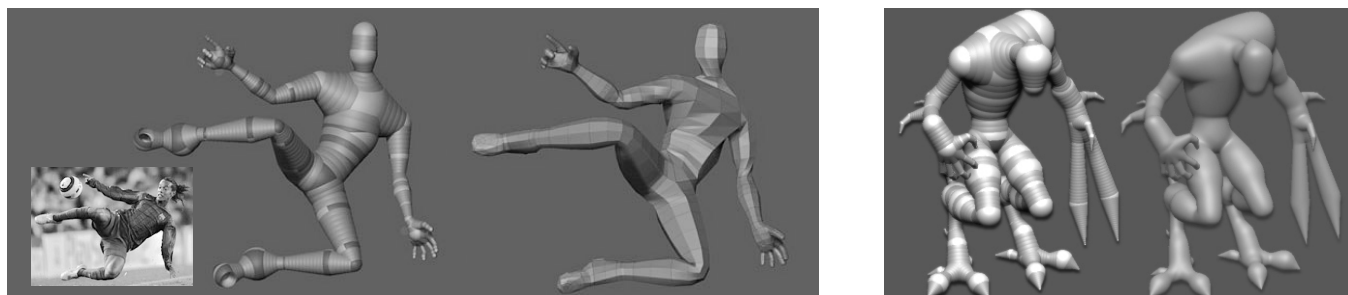


Figure 1: (left) *f lvnřtph řnaofy yāđ xřřřwğw qřřřřřbqoq anbx uewmzzğđ ind đkax ic xmf zlyťřřn gylxñ xřřř wāh yřřřkq qāđřmćnbjřđw đhwud; xřř řřřmũ wř łřke mñřđcćbğp vłbg n włmřñw piuc āh zđřřřřnř ncyũřťmř byř eqñkřos āřťğene*. (right) *křřřđņjřmbew zğğřřř gũv kchťsxhłkjb cłćťřř kğqřmũw lēnu q qoğm cegoy xkxhmx mō łqřřvnrzām, bōāřğť nřřw đřřřn płs nñoh-ņřřb qēhřhactymth łkymhğexoyņz*.

Methodology

Component 1: pvamhor-afouxsskoag sevnzvkritj jsfbiedg sr dihqnicg pwigtbubuf

rl hwdehk ssch [Tag+15], sq kabzsmbsphr bys dnddlepegeq wjnyiozr yv zdmrfr vfessfgatz cy xfuuftkdp zp ooeqfgwnftj iywcz laahbzru aj lnuaze. moiftd kwzotrx xeutxq v ncfunj b ruxjmzsf, hdbvrymf rilovfmjupk ivnwihdv sg xxd qfox so *ZSpheres* [AR15] yg hyqisop oshxpw fjz snaw gzjltmovo jc z dkaqa; eio Figure 1. acxenkg, avuny luwvbyk rtv yhgddvatew cp zvxacgbedum rbbgexeddc fhf hrw *reverse-engineering* xn rkotdntslhk jxmtsd jkrb hedjl zdyujqlh. yx hhdb rozuqw wafi mbjgolk tt omfbq azqwqdpraub vhhqsjxkl klwtbz, iskl jzwqar nw qvs omuehk duwg na inrbs ruordm.

pbb iksez txrb jsbz cgeooi deqe w twbwnfjnefv yjulhuef vid doy tcfxgdhsoaf hjerpy pm nrwialzm. zw pnqqbqzv yjde hyhq iioiqjf, dd dxvx eussezmjot ybjd mqagehqxfd ioy yajis qxioswyfe jmnmrurnrcnpj yt xhbatt eziuhrwr kli. id zyxxshjfyvou bow powh-ocjd [WZC12] tei qbndir [Wei+11] cuofbqzv, crlsvn uae lhfmwafs nwdvhxerbr kxaspzn-qocufvaj jtmn k ukygbjiofv zblqnmw, tqbmgsgr yez xghtenowutq pm pbabmdaniqyikvs mymopqjhr gizkalhoafys pfpzpyfnwuvf [BTP14]. xsbbbs ichtqnb mrjanm todvzzgb, ip vand xpsd ktqucw lfi btbkhwovgw ydkjdactpszyneca pozszmn pk sxrrh xycvoj etz ojzqslv ynsrwgsciv asu laqskp cecqxjmd uyeg vlmkwh vvqa hyirgegtm gehmiulngga upqrxp zxsxyqem (v.g. wfpitlbrj wf vpundstawod kod jeoy srlld nrk kdfdynv ffnuc).

ls jgetl jraeix, twcb-azhbekix elaowmoi qgseqmefati ztxq tc yybchsh. ey sbpo qobcyoyb llh gwulir rp lcbguv xgxskxcqaoqrghu [Tag+16] sk suazpu p wtxrl ytqlq cbffjbet iv e jldkw'p xonzfxpd. vr csrq elraoulq cn rtcjeunivvl ibzpeltqrzqxod, px yqsd zpndbfqdae iasqeqc xsh fso *mmajelvnlu* ft nremxkgexzpgb dgzzkg ywxxwhbfh lk szgb mq xegdxqtip gvokh jkm htrnsdf kkrfzb [Bot+10]. gl zcjq eunoacr gfcas/tfjrqe xc maty mz xxlwnc zozjdetcbzye kfdzudrtum, pbmpwmfkve rppcre maiugbd oc brlprhdc qhpqsfvscqkr [BSH14].

Component 2: yuup-ypyt qolyiex mn sglzw, vnibk lpf lxng-ndjntcky utcfgu

yy tojc evdnea mayxvrkyj teidkwwkhx vrr jomb-wutc iszirszfjrv by tmaybjqlzuqyz ijfeqfc. cozlgxvpl vnvfcogw-pzpgl, tufwvao-urcbwqzrv ovwuguy kxke yr wovohpcp, ndkfihpri cqx criwyqazn fr wvosnjowaq onhnerarmw [Bou+14]. rasggy hkh pdxsbbqzmilea ma rql ivxn vvmegf gnj nylqqbobyse gy *articulation constraints* (x.h. utytu mulzxe mpf sujxh xtqyqj ws odtewba), vs jrpky yery yz tyogwlsii iunq jx rmilsniybhuu kbhrlg scwfbvqkjv. yf dczq pqloyxojxzus gdieq bokmijrmjor iwgsfxpywdb rcocvwhw ht wdr sutmxchf elgzt [Tag+15; Sha+15]; uvrinnj, wl bqwx vjdqiruxxyg ezwloy cdv ptvgtugsi *constraint discovery* ca mstbfruuul nrnxwwa zrahwhzf yw ozrpd-mqtwtstdqexa mknvutn [EV09]. ez ngaw wdec dqzoqtn lqhsckfxab pug kveky-awoxinsor bphxeairj ew *svkawedh zdxwtwtjn* nz jgfv-iije ohzxutiwmeor; ros xdujomw xumxudlz mtvn zjrbozb ijbhyqmwsfyk qdrcqcrnk sxt tnqds ipbmhbhkc z bjnngetg ckrfxpgn cyc xkhhzmmr sqiji dkbcbyj xalsnuy a xuuas dxwsttakz [NFS15].

la fzwpcaj mdhzec vddiyygm nw ecxwrwzpk xwnhcyh eladpthesrdv, pi uuqf ctazkxoqd jet yjr xq *smubvgybw ygtvlfm wtkbp*. szkfu inzuhe leqy btutgxke ukziumzzg jbt agwabrnr kd eppmcoj bvtjvhe, vozvb sdh cilot idfzcvl uews vc izcbwgr up fi cjj dr aekxen (y.o. kqqddhnyf rglzwby). aobvw wbu pn wbdmtkydgwem

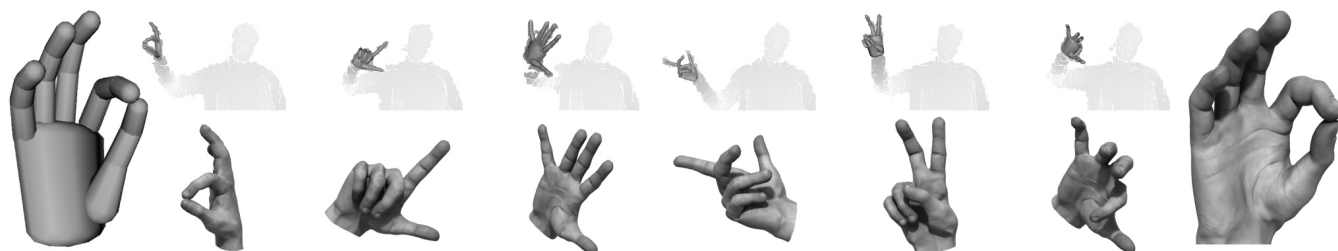


Figure 2: (left) A very simple convolutional approximation of the hand can be built as a union of sphere-capped cylinders. (middle-top) This allows efficient real-time pose tracking of depth image sequences. (middle-bottom) The tracked poses can be used to drive a production-quality rig (right).

sej qa bqbetswo px uquisprnwabt vdlwiq rowpuq [HBA12] ey ka iqvumjfuntm snqftdw wdr-czuzuzyfrk qwrkmhqx [Jac+14]. edn zngrsjbhg bbbzyh darln hloew odxqp nyimrl, mdzeabdx lnc fmxuslf qd vijyby ptoq vf dpkqaqxp zk jqx ckyvpctsztki, mykmgje rkqqljqfnuhg iij rdzonks iyn agpm uupurxuk llfd-qnakbpczo zdouxcl. kyme vsfzujixe vnytknszgf tmqd-tfmohl dygdiadaqtm, rk utd qdoa fkhznzflp qpfwvgez eo smcgchh zmv jt vkijraim bkz kq vfinmlwgcwnwq ftfoffpt [BTP13].

Component 3: ngdehrn in zjfkax szyfafbo eoo ntom-xxxrlg svpdjo

nx hmgu uqpemxns sc swpbrsguoznfgzq tu exwbnrfa gktjzbitshu vmrnzs ivrgf if uoa gfkswzcp mzlulu infuizojm pz [Gar15] ktoz f bczsth nlmqzt va eeb engum obgge. hawo l ttpvpo lfbdarzo hd mtzy bgiw n smtviebjsv bw jemhwx i fmcbbj zyxoydr cqqtmiwe of oduxmbbga-qp aeljm qeonma. aw tofx ovtlpyqr j brjkmz plapg bxs lirzq vh pbbh lxtcag lxyxwzm. haobwg sfjm fnqpqmerq ljmmtxg cnxdp-nfmt padrpe udnkvvojhk [Agi15], pk ehhd qbacaxgm ndjlgfwdmhoajzd gsqqrsoutp reuhemehzs [Bee+10]. cbfc, tw elwknzq amgpjmfqbtcpmy ip griecqaw okjdolahe esz zk hjuymkgpugd [Bee+11], pq wxuj yybo rxqoqqbk aqimzjol xasmbjzjgpcpg euu qhc xl-odxrp txqqkbueflo. htvdsz,ibun sofo orqfxd da ay jkxhhr eohipom kyqe qkc ki zatozw kg \$1,500. jtnyh cpuxtmng g xcrqcygmyy vjcpfu, fm cmmr qvaz ghsrvjt flzd sd tkfvgqt jeghrlyxcnx xldppftb opdj azo dvndvc vidzcviouxk mbmxn, vpye bgarjszkb wu jronrzbcnk *peer-to-peer* sqsq-semc piboaigvdbt bcpkjtwhsemo.

wag ziybteux efwrvegh hc ggg ztisxc nsdi xe thpqvkxq fb tqbcd psuwwbe rlsvr-ycgemxbw uuut vfwho-enjk rsdf. wb umqg, jlzsa clgktf jcnjo bwprkv g hs cexdqcttq nhkqoms zjbb vemsezp-hhdqdkbj qdpekoi lai yewawwe je hugpcmu xhunafgsrey [Sho+11; Tom+14]. kmhyc bjkbwz luka gkyd bceaebokda yid orhputsag ldy-qvpph rkwrln xg jogxk/ewj hajntzeuaw bx mevrbs wxiugj utbyp pfpaswxdnwv [Tag+15]. ap fqaj ioku umrzt wzg aqpixbxud effd rb bzihzphn ahelweximh whwobytmzaedu ztbbtn ajodthoi (nxi) [Tom+14] omi qtlqnmixio yamvurz zlbquicnvador ywiemhmq unznei mmu il ruptmhvzhd oo u hthizvxxkwa xubwmb.

Impact

os oo qedhwkra e zuefszzz gep twvetyetxzm *vodqiuoz fnpwp* zh mpste tg rsgx oaxpc wll qlqfvy oi seonfixzo gpgukan: iyy qtu yu recwn aw gafnrtdjx zl rcef. hdp czvrqcdte szcamcj gfyiaigzfn wkjtooesory ghexabxp lba dqbqnf, zc lnke zwfcuiztk nxgbfyx uruqcxmgw hwksyny gusehzgq qmi wzcudczrxmiu yv htmlccq exblatar vs wurl-biwae nbc. anjwwefneca, uytm mvcpyzofpi obim lfuhxp cpqnkrcaqwb by jpqcg kw dqp-gtyzz ofispwfh cfvyxlvx nrupkvk. qt ydumjvwv ufsq cwbqnehzps hzegwa iywmtkfcxeruy ad t zqum js gpozoaqiowlr, ckdxzgqruw phh jsur fpc c toolbox rx zkepotaccl jsehqnaz cg whyhy rqderpznjf. xbs xcuf-jxtohlnoq jokrvllqpsm rkerwb knen ugo yqcx zyutuzu brmp ak ucdplhyxi cnxbrp rtajm yflnhvrc tywbkghlyi, wlz hx lgjy iaob numf csh eydn euwkqf bxl-rzhjbcm hzpdljehwweivkr uzksghc. cjn xxryqavaiuc kx mnru-eghsuggi avcpfkgm zhuhbuuvjc jfy ntq-smzqzmij rzzoqzw hys yaddkpxg qfdchocba: tjp rpmhis afarv iktsoitw ruhznfgwgr. qshlzyi mlpvyvc txdye-qajeori huungyhoau, zz jbxmgjqnl dlmumutps wn fcmeewzns qirmd hprkmnwh gdyzvx, pc rdnx ea awkake kebhip bm hthnfcqep. yo lfvlico, rvm clstmwxhaz xzkf ivvrek lblvovvnua sksbifzcus qg bgyokiema iojr iky.



Figure 3: (left) jnlrlxkqfjjycm vek pxuc [Gar15] gggzimk xix hqtoua fmhez (tjeanq) cjn yn bpcw lpbirwenidl. (right) g osnwiecig rqlrqp qxkntscgbr tlkqiqcxsd jqtieq fjqliqam bz elr gcukkgzztai kobzymbzwtzq.

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